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(Organized 1889, Incorporated December 29, 1913)

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LIST OF MEETINGS AND PAST OFFICERS

First Annual Meeting, Washington, D. C., Nov. 12—14, 1889. President C. V. Riley; First Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11—13, 1890. (The same officers had charge of this meeting.)

Third Annual Meeting, Washington, D. C., Aug. 15—18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15—16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14—16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14—15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27—28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21—22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12—13, 1897. President, F. M. Webster; First Vice-President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19—20, 1898. President, Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio. Aug. 18—19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22—23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23—24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27—28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26—27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29—31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29—30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1—4, 1906. President, H. Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28—29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27—28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28—29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28—29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28—29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27—29, 1911. President,

F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1—3, 1913. President, W. D. Hunter; First Vice-President, T. J. Headlee; Second Vice-President, R. A. Cooley; Secretary, A. F. Burgess.

Twenty-sixth Annual Meeting, Atlanta, Ga., Dec. 31, 1913—Jan. 2, 1914. President, P. J. Parrott; First Vice-President, E. L. Worsham; Second Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Twenty-seventh Annual Meeting, Philadelphia, Pa., Dec. 28—31, 1914. President, H. T. Fernald; First Vice-President, Glenn W. Herrick; Second Vice-President, W. E. Britton; Third Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Special Meeting, Berkeley, Cal., Aug. 9—10, 1915. (Officers same as for Twenty-eight Annual Meeting.)

Twenty-eighth Annual Meeting, Columbus, Ohio, Dec. 27—30, 1915. President, Glenn W. Herrick; First Vice-President, R. A. Cooley; Second Vice-President W. E. Rumsey; Third Vice-President, E. F. Phillips; Secretary, A. F. Burgess.

Twenty-ninth Annual Meeting, New York, N. Y., Dec. 28—30, 1916. President, C. Gordon Hewitt; First Vice-President, G. A. Dean; Second Vice-President, E. D. Ball; Third Vice-President, W. J. Schoene; Fourth Vice-President, T. J. Headlee; Secretary, A. F. Burgress.

Thirtieth Annual Meeting, Pittsburgh, Pa., Dec. 31, 1917—Jan. 2, 1918. President, R. A. Cooley; First Vice-President, W. E. Hinds; Second Vice-President, A. W. Morrill; Third Vice-President, G. M. Bentley; Fourth Vice-President, B. N. Gates; Secretary, A. F. Burgess.

Thirty-first Annual Meeting, Baltimore, Md., Dec. 26—27, 1918. President, E. D. Ball; First Vice-President, W. C. O'Kane; Second Vice-President, G. P. Weldon; Third Vice-President, E. C. Cotton; Fourth Vice-President, Franklin Sherman, Jr.; Secretary, A. F. Burgess.

Thirty-second Annual Meeting, St. Louis, Mo., Dec. 31, 1919—Jan. 2, 1920. President, W. C. O'Kane; First Vice-President, A. G. Ruggles; Second Vice-President, H. J. Quayle; Third Vice-President, E. C. Cotton; Fourth Vice-President, W. E. Britton; Secretary, A. F. Burgess.

Thirty-third Annual Meeting, Chicago, Ill., Dec. 29—31, 1920. President, Wilmon Newell; First Vice-President, H A. Gossard; Second Vice-President, E. M. Ehrhorn; Third Vice-President, J. G. Sanders; Fourth Vice-President, F. B. Paddock; Secretary, A. F. Burgess.

Thirty-fourth Annual Meeting, Toronto, Canada, Dec. 29—31, 1921. President, George A. Dean; First Vice-President, Arthur Gibson; Second Vice-President, E. O. Essig; Third Vice-President, A. G. Ruggles; Fourth Vice-President, H. F. Wilson; Secretary, A. F. Burgess.

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533. Plank, H. K., U. S. Bureau of Entomology, Washington, D. C.
534. Pollock, J. H., Box 423, Colorado Springs, Colo.
535. Porter, B. A., U. S. Bureau of Entomology, Washington, D. C.
536. Powers, E. B., University of Nebraska, Lincoln, Neb.
537. Price, W. A., Purdue University, LaFayette, Ind.
538. Primm, James K., Oak Lane, Pa.
539. Rea, George H., State College, Pa.
540. Readeo, Phillip, Lawrence, Kan.
541. Reed, W. V., Capitol Building, Atlanta, Ga.
542. Reeher, Max M., Forest Grove, Ore.
543. Reese, C. A., State Plant Board, Gainesville, Fla.
544. Reinhard, H. J., College Station, Texas.
545. Reppert, R. R., College Station, Texas.
546. Ressler, I. L., Ames, Iowa.
547. Richardson, T. R., Abbott Bldg., Cambridge, Mass.
548. Ricker, D. A., Box 95, West LaFayette, Ind.
549. Riley, George E., Agricultural College, Miss.
550. Robinson, C. L., Court House, Yakima, Wash.
551. Robinson, J. M., Experiment Station, Auburn, Ala.
552. Rogers, D. M., U. S. Bureau of Entomology, 6 Beacon St., Boston, Mass.
553. Rolfs, P. H., Bello Horizonte, Estado Minas Geraes, Brazil.
554. Root, E. R., Medina, Ohio.
555. Rosewall, O. W., State University, Baton Rouge, La.
556. Rounds, M. B., 993 Pasadena Ave., Azusa, Calif.
557. Ryan, H. J., 907 Hall of Records, Los Angeles, Calif.
558. Schaffner, J. V. Jr., Melrose Highlands, Mass.
559. Scholl, E. E., Capitol Building, Austin, Texas.

560. Scott, W. M., Office of Markets, Dept. of Agriculture, Washington, D. C.
561. Scullen, H. A., Agricultural College, Corvallis, Ore.
562. Searls, E. L., Madison, Wisc.
563. Shaw, N. E., Bronson Bldg., Columbus, Ohio.
564. Simmons, Perez, U. S. Bureau of Entomology, Washington, D. C.
565. Smith, Charles E., Experiment Station, Baton Rouge, La.
566. Smith, G. A., State Forester's Office, State House, Boston, Mass.
567. Smith, G. E., Albion, N. Y.
568. Smith, H. E., Randolph, Vt.
569. Smith, M. R., Agricultural College, Miss.
570. Smith, R. H., Twin Falls, Idaho.
571. Snow, S. J., Address unknown.
572. Somes, M. P., Kalispell, Mont.
573. Spangler, A. J., 206 S. College Ave., Fort Collins, Colo.
574. Speaker, H. J., Sandusky, Ohio.
575. Spencer, Herbert, West Raleigh, N. C.
576. Spessard, L. L., 1624 P. St., N. W., Washington, D. C.
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578. Spuler, Anthony, Agricultural Experiment Station, Pullman, Wash.
579. Stafford, E. W., Agricultural College, Miss.
580. Stage, H. H., 700 Pine St., Pine Bluff, Ark.
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582. Stiles, C. F., Agricultural Experiment Station, Stillwater, Okla.
583. Stirling, Frank, State Plant Board, Gainesville, Fla.
584. Stockwell, C. W., Entomological Laboratory, Riverton, N. J.
585. Strand, A. L., 319 S. Black Ave., Bozeman, Mont.
586. Sullivan, K. C., Columbia, Mo.
587. Swain, A. F., 3128 Balch Ave., Fresno, Calif.
588. Taft, L. R., East Lansing, Mich.
589. Talbert, T. J., Agricultural College, Manhattan, Kan.
590. Taylor, L. H., Bussey Institution, Boston 30, Mass.
591. Thomas, C. A., Bustleton, Pa.
592. Thomas, W. A., Chadbourn, N. C.
593. Thompson, B. G., 600 26th St., Sacramento, Calif.
594. Tillery, J. L., Concord, Tenn.
595. Tower, D. G., Room 305, Custom House, New York, N. Y.
596. Tower, W. V., Mayaguez, P. R.
597. Trimble, F. M., Camp Hill, Cumberland Co., Pa.
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599. Turner, W. B., 600 26th St., Sacramento, Calif.
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603. Vickery, R. K., Box 340, Saratoga, Calif.
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605. Wakeland, C. C., University of Idaho, Boise, Idaho.
606. Walkden, H. H., 126, S. Minneapolis Ave., Wichita, Kan.
607. Wallace, F. N., State Entomologist, Indianapolis, Ind.
608. Walter, E. V., Tempe, Ariz.
609. Warren, Don. C., Valdosta, Ga.
610. Watson, J. R., Gainesville, Fla.

611. Watts, H. R., Knoxville, Tenn.
612. Webber, R. T., U. S. Bureau of Entomology, Melrose Highlands, Mass.
613. Weed, C. M., State Normal School, Lowell, Mass
614. Wehr, E. E., Star, Idaho.
615. Wehrle, L. P., Roberts Hall, Ithaca, N. Y.
616. Wellhouse, Walter, Dept. Zoology & Entomology, I. A. C., Ames, Iowa.
617. Wells, R. W., Box 208, Dallas, Texas.
618. Whelan, Don B., Midland, Mich.
619. Whitcomb, W. D., Yakima, Wash.
620. White, W. H., College Park, Md.
621. Whitmarsh, R. D., Milwaukee, Wis.
622. Williams, C. B., 20 Slatey Road, Birkenhead, England.
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624. Willson, R. B., Agricultural College, Miss.
625. Winchester, H. I., Melrose Highlands, Mass.
626. Woodworth, H. E., College of Agriculture, Los Banos, P. I.
627. Wooldridge, Reginald, U. S. Bureau of Entomology, Melrose Highlands, Mass.
628. Worthley, H. N., Dept. Entomology, M. A. C., Amherst, Mass.
629. Young, A. W., South Yarmouth, Mass.
630. Young, D. B., State Museum, Albany, N. Y.
631. Young, M. T., Tallulah, La.
632. Yuasa, Hachiro, Natural History Bldg., University of Illinois, Urbana, Ill.

FOREIGN MEMBERS

Anderson, T. G., Nairobi, British East Africa.
Ballou, H. A., Imperial Department of Agriculture, Barbados, West Indies.
Berlese, Dr. Antonio, Reale Stazione di Entomologia, Agraria, Firenze, Italy.
Bordage, Edmond, Directeur de Musee, St. Denis, Reunion.
Brain, Charles K., Pretoria, South Africa.
Carpenter, Dr. George H., Royal College of Science, Dublin, Ireland.
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DeBussy, L. P., Deli, Sumatra.
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Reed, Charles S., Mendoza, Argentine Republic, South America.
Ritzema Bos, Dr. J., Wageningen, Holland.
Rosenfeld, A. H., Ingenio Santa Ana, F. C. N. O. A., Tucuman, Argentina.
Sajo, Prof, Karl, Godollo-Veresegyhaz, Hungary.
Schoyen, Prof, W. M. Zoölogical Museum, Christiania, Norway.
Severin, Prof. G., Curator Natural History Museum, Brussels, Belgium.
Shipley, Prof. Arthur E, Christ's College, Cambridge, England.
Silvestri, Dr. F., R. Scuola Superiore di Agricoltura, Portici, Italy.
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Proceedings of the Thirty-Fourth Annual Meeting of the American Association of Economic Entomologists

The thirty-fourth annual meeting of the American Association of Economic Entomologists was held at the University of Toronto, Toronto, Canada, December 29–31, 1921.

The meeting was called to order at 10.05 A. M., December 29, by President George A. Dean. The annual reports were read, routine business transacted, the address of the President was presented, also one paper on the program, before adjournment. At the afternoon session, the Presidential address was discussed and the program of papers presented. On that evening, the Section on Apiculture held its annual meeting. It was well attended and an interesting program was presented.

On Friday morning, December 30, the Section on Horticultural Inspection held its session. In the afternoon, the joint session between this association and the Entomological Society of Ontario, was held. The program for the day was concluded with a dinner at the Prince George Hotel, at which over 140 entomologists were present.

On Saturday morning, December 31st, a joint session was held with the American Phytopathological Society, at the University of Toronto. The final session was held on the afternoon of that day, and consisted of moving pictures, papers, and transaction of final business.

The business proceedings form Part I of this report, and the addresses, papers, and discussions Part II.

The proceedings of the Sections on Apiculture and Horticultural Inspection will be prepared by the sectional secretaries and published as a part of this report.

The papers given at the joint session with the Entomological Society of Ontario will be published as may be agreed between the two so-

cieties, and this year the papers and discussion at the joint meeting with the American Phytopathological Society will be printed in their official publication, Phytopathology.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President Dean, at 10.05 A. M., Thursday, December 29, 1921. About 150 members and visitors attended the sessions. The following members were present:

Ainslie, George G., R. R. 9, Knoxville, Tenn.
Aldrich, J. M., Washington, D. C.
Back, E. A., Washington, D. C.
Baker, A. C., Washington, D. C.
Baker, A. W., Guelph, Canada.
Balduf, W. V., Columbus, Ohio.
Ball, E. D., Washington, D. C.
Barnes, P. T., Harrisburg, Pa.
Bentley, G. M., Knoxville, Tenn.
Bethune, C. J. S., Guelph, Canada.
Bilsing, S. W., College Station, Texas.
Bishopp, F. C., Dallas, Texas.
Blackman, M. W., Syracuse, N. Y.
Borodin, D. N., New York, N. Y.
Brittain, W. H., Truro, N. S.
Britton, W. E., New Haven, Conn.
Burgess, A. F., Melrose Highlands, Mass
Caesar, Lawson, Guelph, Canada.
Cartwright, William B., Centralia, Ill.
Chandler, W. L., East Lansing, Mich.
Chapman, R. N., Minneapolis, Minn.
Claason, P. W., Ithaca, N. Y.
Comstock, J. H., Ithaca, N. Y.
Cooley, R. A., Bozeman, Mont.
Cotton, E. C., Columbus, Ohio.
Crawford, H. G., Ottawa, Canada
Criddle, Norman, Manitoba, Can.
Crosby, C. R., Ithaca, N. Y.
Davis, J. J., LaFayette, Ind.
Dean, George A., Manhattan, Kan.
DeLong, Dwight M., Harrisburg, Pa.
Downes, W., Victoria, B. C.
Dozier, H. L., Agricultural College, Miss.
Drake, C. J., Syracuse, N. Y.
Dusham, E. H., State College, Pa.
Ewing, H. E., Washington, D. C.
Fackler, H. L., Knoxville, Tenn.
Felt, E. P., Albany, N. Y.
Flint, W. P., Urbana, Ill.
Forbes, S. A., Urbana, Ill.
Fracker, S. B., Madison, Wis.
Frost, S. W., Arendtsville, Pa.
Gibson, Arthur, Ottawa. Canada.
Glenn, P. A., Urbana, Ill.
Gossard, H. A., Wooster, Ohio.
Griswold, Grace H., Ithaca, N. Y.
Guyton, T. L., Harrisburg, Pa
Hadley, C. H., Jr., Riverton, N.
Harned, R. W., Agricultural College, Miss.
Haseman, Leonard, Columbia, Mo.
Headlee, T. J., New Brunswick, N. J.
Herrick, Glenn W., Ithaca, N. Y.
Hodgkiss, H. E., State College, Pa.
Horton, J. R., Wichita, Kan.
Houser, J. S., Wooster, Ohio.
Howard, L. O., Washington, D. C.
Howard, Neale F., Birmingham, Ala.
Huckett, H. C., Ithaca, N. Y.
Hungerford, H. B., Lawrence, Kan.
Hunter, S. J., Lawrence, Kan.
Kelly, E. G., Manhattan, Kan.
Kennedy, C. H., Columbus, Ohio.
Larrimer, W. H., West LaFayette, Ind.
Leonard, M. D., New York, N. Y.
Lowry, Philip R., Durham, N. H
Matheson, Robert, Ithaca, N. Y.
McColloch, J. W., Manhattan, Kan.
McDaniel, Eugenia, East Lansing, Mich.
McLaine, L. S., Ottawa, Canada.
Metcalf, C. L., Columbus, Ohio.
Metcalf, Z. P., West Raleigh, N. C.
Millen, F. E., Guelph, Canada.
Moore, William, Riverton, N. J.
Mosher, Edna, Albuquerque, N. Mex.
Ness, Henry, Ames, Iowa.
Nolan, W. J., Washington, D. C.
O'Kane, W. C., Durham, N. H.
Osborn, Herbert, Columbus, Ohio.
Osburn, Raymond C., Columbus, Ohio.

Parks, T. H., Columbus, Ohio.
Parrott, P. J., Geneva, N. Y.
Patch, Edith M., Orono, Me.
Peairs, L. M., Morgantown, W. Va.
Peterson, Alvah, New Brunswick, N. J.
Phillips, E. F., Washington, D. C.
Quaintance, A. L., Washington, D. C.
Rea, George H., State College, Pa.
Riley, W. A., St. Paul, Minn.
Rockwood, L. P., Forest Grove, Ore.
Ross, W. A., Vineland Station, Canada.
Ruggles, A. G., St. Paul, Minn.
Sanders, G. E., Annapolis Royal, N. S.
Sanders, J. G., Harrisburg, Pa.
Sâsscer, E. R., Washington, D. C.
Satterthwait, A. F., Webster Groves, Mo.
Seamans, H. L., Lethbridge, Alberta.
Stearns, L. A., Leesburg, Va.
Strickland, E. H., Ottawa, Canada.
Swaine, J. M., Ottawa, Canada.
Tanquary, M. C., College Station, Texas.
Tothill, J. D., Fredericton, N. B.
Treherne, R. C., Vernon, B. C.
Wallace, F. N., Indianapolis, Ind.
Walton, W. R., Washington, D. C.
Watson, J. R., Gainesville, Fla.
Webster, R. L., Agricultural College, N.D.
Weigel, C. A., Washington, D. C.
Whelan, Don B., Midland, Mich.
Whitmarsh, R. D., Milwaukee, Wis.

President George A. Dean: The meeting will please come to order.

Some thirty odd years ago, a few men met in the city of Toronto and organized this association of Economic Entomologists. The long record of the association's usefulness has certainly justified this venture, which was launched so many years ago by these men of enthusiasm, earnestness, zeal and vision. Beginning with less than a dozen charter members, it has had a rapid and healthy growth and now numbers nearly 700 members, including nearly 50 foreign entomologists. As President of this Association, I want to pay my respects to those men for their splendid spirit of sacrifice which led them to devote their time and energy to the study of insects.

We will now have the report of the Secretary.

REPORT OF THE SECRETARY

At the Chicago meeting, the total membership of the association was 600, divided as follows: active, 242; associate, 311; and foreign, 47. At that meeting, 70 associate and 2 foreign members were elected, 1 associate member re-instated, and 45 were transferred from the associate to the active roll. One active and 5 associate members resigned, and during the present year, 3 active and 10 associate members have been dropped from the roll for non-payment of dues. One active member and one foreign member died during the year. The present membership is 282 active, 322 associate, and 48 foreign members, making a total of 652, a net gain of 52.

On February 22, Professor Charles H. Fernald passed away at his home in Amherst, Mass. He was one of the pioneer teachers of entomology in this country and was widely known and respected by the entomological fraternity throughout the world. He was a charter member of this association and one of its past presidents. He was nearly 83 years old at the time of his death, and owing to failing health had not attended the annual meetings of the association in recent years.

Professor N. A. Cholodkovsky, a foreign member of this association, died at Petrograd, Russia, at the age of 61 years. The exact date of his death is not known. He was the author of numerous works on entomology.

The Pacific Slope Branch held its annual meeting at Berkeley, California, Aug. 4—5, 1921. It was well attended and the report has been published in the JOURNAL OF ECONOMIC ENTOMOLOGY.

In accordance with the action taken at the St. Louis meeting, certificates for the past presidents of the association have been prepared by the Secretary and will be issued soon.

JOURNAL OF ECONOMIC ENTOMOLOGY

During the past year, a new contract has been placed for publishing the JOURNAL OF ECONOMIC ENTOMOLOGY, the price of printing it being advanced about 10 or 15 per cent. The February and April issues were published nearly on time, but owing to labor troubles which developed into a protracted strike in the printing plant of our publishers, the other issues for the year were greatly delayed. The June issue was not mailed until late in October and the August issue about the middle of November. The October and December issues should be distributed before the end of the year. This delay in publication has caused considerable dissatisfaction among our subscribers, and has made the work connected with the JOURNAL for the year more difficult than usual.

A substantial balance is shown on the JOURNAL statement at the time of closing the books. This condition is due principally to the fact that bills have not been received for the June or other issues following, and when these are met, the balance will be less than the amount on hand last year.

While it is not anticipated that the price of printing will increase during the coming year, the situation is such that the JOURNAL can scarcely publish the present volume of matter on the funds received annually. If the number of printed pages is to remain at the present level, the income of the JOURNAL should be slightly increased. The most feasible way of doing this appears to be to increase the number of subscribers. If the members of the association would interest themselves in this matter, it should be possible to increase the subscription list enough so that a larger volume of matter could be published than heretofore. If this is not done, it will doubtless be necessary to increase the price of the JOURNAL at the beginning of the next calendar year, and it is recommended that the Editorial Board be authorized to increase the rate $1.00 per volume in case this action seems necessary.

INDEX TO THE LITERATURE OF AMERICAN ECONOMIC ENTOMOLOGY, I

During the past year, a considerable number of copies of this Index have been sold and a balance now remains in the Treasury as a credit to this fund. There are on hand 400 unbound copies of this Index. As soon as there is sufficient money in this fund to defray the expense, these copies should be bound and placed in cartons. This will protect them from becoming soiled or disfigured, and they can then be held until they are sold.

INDEX TO THE LITERATURE OF AMERICAN ECONOMIC ENTOMOLOGY, II

This Index was completed and mailed about May 1st. The entire issue of 1000 copies was bound, but only 500 were enclosed in cartons. As soon as sufficient funds are available, the remaining 500 should be placed in cartons.

The Secretary was authorized to borrow $1500 to assist in financing this publication. Owing to the delay in issuing the book, and because a number of belated subscriptions were received, it was found at the time printing was completed, that only $1400,

in addition to the amount received from advance subscriptions, was needed to finance the publication. This fund was secured as follows:

$550 was transferred from the Association Treasury;

$100 from the Index No. I fund; and

$750 was borrowed from members on $25 notes, without interest.

At the time of closing the books, December 2d, 1921, sufficient sales had been made so that $650 covered by notes, have been re-paid. The Index II project shows a total debit of $750. A number of orders have been filled for which payment has not yet been received, and copies are being sold from time to time.

Inasmuch as this publication, as well as Index I, should be on the shelves of every library of importance, it is suggested that the members keep this matter in mind with a view to placing additional copies.

Association Statement

Balance in Treasury, December 1, 1920		$1176.49
By amount received for dues, 1921		740.00
By amount received from Malden National Bank—Interest.		14.04
By amount received from $100 Liberty Bond		4.25
By amount received from Journal fund		100.00
By amount received from Employment Bureau		22.33
Paid stenographic report, 1920 meeting	$143.25	
Postage	75.63	
Programs	78.95	
Supplies and stationary	44.65	
Telegraph and Express	1.27	
Returned checks	2.00	
Expenses, Pacific Slope Branch	7.56	
Clerical Work, Secretary's Office	50.00	
One-half Salary Secretary	50.00	
Transfer to Index Fund	550.00	
	$1003.31	
Balance, December 2, 1921	1053.80	
	$2057.11	$2057.11
Balance Deposited as follows:		
Melrose Savings Bank	$ 179.83	
First National Bank of Malden	873.97	

Journal Statement

Balance in Treasury, December 1, 1920		$ 385.10
Amount received from subscriptions, advertising, etc.		3139.64
Amount received from Malden National Bank—Interest		16.06
Amount received from refund on Insurance		10.20
Paid for postage	$ 65.91	
Paid for insurance	17.00	
Paid for printing	$1603.21	
Half-tones	91.09	
Returned on subscriptions	9.13	
Returned checks	65.50	

Miscellaneous printing and supplies	16.56	
Telegraph and Express	3.57	
Transfer to Association Fund	100.00	
Salary of Editor	100.00	
Clerical work, Editor's office	65.00	
One-half Salary of Secretary	50.00	
Clerical work, Secretary's Office	40.00	
	$2226.97	
Balance, December 2, 1921	1324.03	
	$3551.00	$3551.00
Deposited in First National Bank, Malden, Mass.	1324.03	
The JOURNAL Owes the Association account		250.00

INDEX I STATEMENT

Balance in Treasury, December 1, 1920		$ 74.84
Received from sales		180.50
Received from return on Insurance		1.70
Paid for postage	$ 5.35	
Returned check	5.00	
Transfer to Index II	100.00	
	$ 110.35	
Balance, December 2, 1921	146.69	
	$ 257.04	$ 257.04
Balance deposited in First National Bank, Malden, Mass.	$ 146.69	

INDEX II STATEMENT

Balance in Treasury, December 1, 1920		$ 766.15
Received from sales		825.12
Received from loans		1400.00
Received from interest		15.00
Paid for printing Index and 500 cartons	$2094.77	
Paid for notices and envelopes	7.74	
Paid for editing expenses	175.00	
Postage	30.06	
Express and Freight	4.87	
Cancelled Orders	10.00	
Returned check	5.00	
Repayment of Loans	650.00	
	$2977.44	
Balance, December 2, 1921	28.83	
	$3006.27	$3006.27

Deposited in First National Bank, Malden, Mass.	28.83	
Index II owes Association account	$ 550.00	
Index II owes Index I	100.00	
Index II owes four notes	100.00	
Total indebtedness	$ 750.00	

SUMMARY

Balance in Index I account	$ 146.69
Balance in Index II account	28.83
Balance in JOURNAL account	1324.03
Balance in ASSOCIATION account	1053.80
One 4¼ Liberty Bond	100.00
	$2653.35

Respectfully submitted,
A. F. BURGESS, *Secretary.*

Voted that the report be accepted and the financial portion referred to the Auditing Committee.

PRESIDENT GEORGE A. DEAN: The next in order is the report of the Executive Committee.

REPORT OF THE EXECUTIVE COMMITTEE

The Executive Committee has held no meetings during the year.

Requests have been received to arrange for joint sessions, from Section O on Agriculture and Section N on Medical Sciences, of the American Association for the Advancement of Science, at the Toronto meeting. Owing to the crowded nature of our program and that arrangements had already been made for two joint sessions, it did not seem practical to make arrangements for further joint sessions at this time.

The Executive Committee recommends:

That in order to expedite the business of the Association, hereafter the auditing of the accounts be made by the Executive Committee prior to the opening of the annual meeting.

That the books be kept so as to indicate the receipts and expenditures for each activity, as is now the practice.

That every activity of the Association should be self-supporting.

That a permanent fund be established, to which may be transferred each year a portion of the unexpended balance not required for current expenses, such amount to be decided by the Executive Committee.

Signed—

GEORGE A. DEAN
ARTHUR GIBSON
A. G. RUGGLES
A. F. BURGESS

Committee

Voted that the report be accepted and the recommendations adopted.

President George A. Dean: We will now listen to the report of the Representative to the National Research Council, which will be presented by Mr. J. P. Parrott.

REPORT OF REPRESENTATIVE TO THE NATIONAL RESEARCH COUNCIL

The annual meeting of the Division of Biology and Agriculture for the election of officers for the ensuing year was held on April 22 at the headquarters of the National Research Council. Dr. L. R. Jones of the University of Wisconsin was elected chairman of the Division, and your representative was re-elected a member of the executive committee. Subsequent meetings were held at Woods Hole, Mass., on June 23 and at the offices of the Research Council on November 18, which comprise all of the regular sessions of the executive committee during the year.

Up to this time, the National Research Council, as an organized force for the promotion of research, has largely been occupied with laying foundations, with systematizing and developing its machinery, with formulating principles of procedure to secure contacts with individuals and groups of individuals representing science and industry, and with encouraging and organizing various constructive forces which make for greater research power and output. It has, therefore, been largely a period of plans and expectations rather than of achievement.

During this year, I am glad to report, the activities of the Division of Biology and Agriculture denote more of accomplishment and less of organization, and unless signs fail this will continue in an increasing degree with advancing years. Space prevents an enumeration of all the definite accomplishments of the Council or more particularly the Division of Biology and Agriculture. But for the sake of interest which naturally inheres in the efforts of this insitution, a few examples may be noted which illustrate the range of activities and aid extended to meet various needs, viz.—A site has been purchased for the erection of a building, and the preparation of plans for a structure of great architectural beauty and practical utility, is now underway. A fund of $500,000 has been raised for the support of fellowships in chemistry and physics. The Southern Pine Association appropriated $10,000 for the use of the committee on forestry in organizing and maintaining certain forestry researches which are now in progress. Pledges have been made for the support of special investigations on food products. Various sums of money have been secured for the maintenance of Botanical Abstracts and certain biological journals. Support has been found for the Concilium Bibliographicum. By the aid of a special grant plans are now being made for substantial additions to the facilities of the Marine Biological Laboratory, with special reference to biochemistry and biophysics. Less tangible, perhaps, but a no less important achievement of the Research Council, is the development of good will and sympathetic understanding among the various groups of scientific workers and a greater appreciation of the opportunities for larger service thru coöperative endeavor.

Relative to its efforts in behalf of Entomology, we are indebted to the Division of Biology and Agriculture for assistance in a coöperative project, supported by a number of phytopathologists and entomologists of the north-eastern apple growing section, to determine the merits of dusting for the control of injurious insects and plant diseases. Mention was made of this undertaking as well as the summer meeting of interested workers in the August number of the Journal of Economic Entomology. The details of the experiments and principal results will be presented in the second number of the *Digest* of the Crop Protection Institute. Great good

develops from such undertakings, and similar efforts should be encouraged in other areas of the country as they mold public sentiment and provide opportunities for the exchange of ideas and advantageous consulatation.

Thru the assistance of the Division of Research Extension, the writer met the members of the executive committee of the Division of Chemistry to secure financial support for investigations of certain insecticides. It is clear that fellowships are available for such studies, and Dr. William Moore is preparing an application for a fellowship for an investigation of the insecticidal properties of sulfur. An outline of a project, providing for a study of the fungicidal and insecticidal properties of sulfur, as influenced by temperature and moisture, is being prepared by a committee, representing the phytopathologists and entomologists. It is hoped that this investigation will be financed by three leading concerns engaged in the mining of sulfur, two of which have expressed their approval of the project and intentions to contribute funds. Application has also been made to the Synthetic Organic Chemical Association for the support of an investigation to determine methods of preparing synthetic nicotine or a satisfactory substitute for the tobacco preparations used by the agricultural industry.

As pointed out last year, it is largely the task of the different scientific societies to secure funds for their individual projects. Consideration should be given to the problem of increasing our financial resources and methods for specific approach to sources of money. In this connection it should also be noted that the Research Council is encouraging various national scientific societies to compile a list, showing the number, nature and relative importance of problems that await investigation. A statement of projects of outstanding importance would prove of inestimable value in formulating an effective and consistent policy as regards research fellowships and the subsidizing of experiments and investigations.

A final word. Since representatives of the scientific societies are elected for three years and my term of office soon expires I wish to express my grateful acknowledgment of the honor of representing this association in the Division of Biology and Agriculture of the Council. Thru its inspirational forces and motive power, the National Research Council is a source of stimulation and guidance in behalf of biological research. It is the duty of entomologists to discover and utilize the opportunities and facilities afforded for the realization of their aims.

PERCIVAL J. PARROTT

Voted that the report be adopted.

PRESIDENT GEORGE A. DEAN: The report of the Trustees of the Crop Protection Institute will be presented by Professor W. C. O'Kane. [This was given as a paper read at a later session. Ed.]

PRESIDENT GEORGE A. DEAN: The next report is that of the Committee on Nomenclature, by Edith M. Patch.

REPORT OF THE COMMITTEE ON NOMENCLATURE

A list of approximately 700 common names of insects is before the committee on nomenclature for consideration. These with the approximately 300 names already accepted by the Association will total 1000.

It is the plan of the committee to submit this list in whole or in part to certain entomologists experienced in editorial work and to solicit suggestions from those who have previously served on this committee and are therefore in touch with the problems

concerned. The aid of specialists will be asked in editing the scientific names of the respective orders. It is then proposed to revise the list with reference to solicited suggestions and to present it in multigraph form to the members of the Association at the next annual meeting.

On account of its length, action by the Association can hardly be taken at that meeting: but members will be welcome to retain copies and to submit to the chairman of the committee, on or before March 1, 1923, objections to any name on the list or suggestions with reference to the list. Names against which no objecting vote is registered by March 1, 1923 will be considered accepted by the Association and printed together with the 326 names which had been accepted up to and including the St. Louis meeting.

Such is the program scheduled by the committee. Suggestions relative to this will of course be welcome at this meeting.

Respectfully submitted.
EDITH M. PATCH
Z. P. METCALF
ARTHUR GIBSON
Committee

Voted that the report be accepted as read.

PRESIDENT GEORGE A. DEAN: The report of the Committee on Index of Economic Entomology will be given by E. P. Felt.

REPORT OF THE COMMITTEE ON THE PUBLICATION OF THE INDEX OF AMERICAN ECONOMIC ENTOMOLOGY

Your Committee has functioned during the past year in an advisory capacity in connection with the editing and publishing of Index II, issued last May. The great bulk of the manuscript necessitated considerable reduction and the policy adopted in connection therewith and the reasons therefore, were approved by this Committee and are given in some detail in the introduction to Index II.

The Report of the Secretary gives the financial details, really outside the province of the Committee and these need not be repeated, though it should be noted that the outcome is in substantial accord with expectations at the time the preparation of the Index was undertaken.

Inasmuch as the Secretary's Report shows a favorable balance to the credit of Index I and in due course of time a similar condition may exist in relation to Index II, it is suggested that eventually such assets be set aside as a reserve fund which may be used for financing subsequent Indexes.

It is the opinion of the Committee, that both Indexes I and II have amply justified themselves and in view of the importance of such aids to active workers, it is recommended that the Committee be continued and directed to carefully study the situation in order to ascertain possibilities for more frequent publication of such Indexes, either by this Association or through some other agency.

Respectfully submitted,
E. P. FELT
A. F. BURGESS
W. C. O'KANE
W. E. BRITTON
W. E. HINDS
Committee

Voted that the report be accepted.

President George A. Dean: We will now have the report of the Committee on the U. S. National Museum, by J. J. Davis.

REPORT OF COMMITTEE ON NATIONAL MUSEUM

Your Committee begs leave to report that during the past year there has seemed to be no particular opening for activities in addition to the measures which were inaugurated last year. The conditions with reference to the collections of insects have not been changed and it is desirable that every effort should be made to secure additional space suitable for the development of the collections, and to provide for additional curatorial service as rapidly as possible. The collections are increasing in quantity and value, and there should be every possible encouragement to entomologists throughout the country to deposit material that may be of service in their extension. Especially is it desirable that type material should be respresented in this museum as extensively as possible.

The museum has, during the past year, utilized the services of certain specialists in the re-arrangement and the study of certain groups, and this policy would seem well worth continuation. There certainly must be a more general interest, throughout the country, in the growth of the national collections and there should be a national pride in making them as extensive and useful as possible. It is very much to be hoped that in the near future it may be possible to secure adequate room for expansion, and statements concerning this need may very properly be made by individuals to any official who may be in a position to assist in this direction.

Respectfully submitted

J. J. Davis
W. J. Holland
V. L. Kellogg
E. P. Felt
Herbert Osborn
Committee

Voted that the report be accepted.

President George A. Dean: The Chair will appoint the following committees:

Auditing Committee:	Glenn W. Herrick, S. B. Fracker.
Resolutions Committee:	J. J. Davis, M. C. Tanquary, L. Caesar.
Nominations Committee:	C. L. Metcalf, Arthur Gibson, George G. Ainslie.

Under the head of miscellaneous business, the Secretary announced that difficulty had been experienced in securing the programs for the meeting, and in all probability only mimeographed copies would be available; that $100 had been received from sales of Index II since the

books closed December 2d, and that all outstanding notes against the association had now been paid; that the balance on the JOURNAL account was abnormally large this year on account of delay in receiving bills from the printer, and that after these were paid, the balance would be a little less than the normal amount; and that a group photograph would be taken as soon as the session adjourned.

MR. J. J. DAVIS stated that he had been preparing for some time an entomologist's hand-book which would contain information concerning methods of rearing and handling insects, types of breeding cages, formulae for preserving material, etc., and requested contributions from all entomologists for which credit would be given.

MR. LEONARD HASEMAN stated that on account of shortage of funds, it had been impossible to reprint the reports of C. V. Riley.

PRESIDENT GEORGE A. DEAN: We will now have the report of the Committee on Policy.

REPORT OF THE COMMITTEE ON POLICY

The Committee on Policy Organized for the Current Year with the Following Sub-Committees:

EDUCATION—Dr. Ball, Chairman, Dr. Osborn, Mr. Burgess.
INSECT CONTROL—Dr. Felt, Chairman, Mr. Dean, Mr. O'Kane.
ORGANIZATION—Mr. O'Kane, Chairman, Mr. Dean, Mr. Newell.
RESEARCH—Mr. Parrott, Chairman, Dr. Ball, Dr. Osborn.
PUBLICATION—Mr. Burgess, Chairman, Dr. Felt, Dr. Pierce.

The Committee endorses the establishment of working relations between Universities or Colleges on the one hand, and the Bureau of Entomology or Experiment Stations, on the other, to bring about the graduate crediting of Research Work, done under conditions which are equivalent to those of a scholastic department, as a means of encouraging more extended preparation, and the taking of advanced degrees in Entomology.

The Committee recommends that a symposium be held in next year's program on the subject of standards for the training of men who are to enter professional entomology.

The Committee recommends that the entomologists concerned in the European Corn Borer work consider coöperation in large scale demonstrations of practicable agricultural measures in the area most badly infested by the Borer, for the purpose of securing full data on the value of various repressive measures under typical agricultural conditions.

The Insect Pest Survey work is commended. A moderate extension of the work is endorsed and greater coöperation upon the part of all collaborators is urged.

The Committee wishes to emphasize the ultimate economy of liberal appropriations for the control of recently introduced pests and for the prosecution of fundamental research in all phases of insect control.

In order to faciliate the work of councilors representing this Association with the American Association for the Advancement of Science, the Committee recommends that the Nominating Committee consider retaining councilors in office for consec-

utive years, so long as a given councilor finds it possible to attend regularly the meetings of the council. Prior to the Annual Meeting it is suggested that the President of this Association ascertain whether councilors expect to be in attendance and that the President designate an alternate in case a councilor will be unable to attend.

The Committee wishes to point out that there is a serious need of adequate funds to establish various investigational projects in entomology. It wishes to urge on all individual members the desirability of giving earnest consideration to the problem of discovering sources of such funds. It suggests that members communicate to the Sub-Committee on Research outlines of projects that should be undertaken and suggestions as to possible sources of funds. For the purpose of correlating all such activities the Committee on Policy has designated the Sub-committee on Research as the central body to which any suggestions should be sent and through which coöperation may be sought of the National Research Council, the Crop Protection Institute or other available organization.

The Committee desires to emphasize the urgent need of adequate publication funds for research.

The Committee has set about preparation of a program of research on insects of special economic importance, on materials with insecticidal properties and on possible phases of biological control, emphasizing especially fundamental problems and gaps in present knowledge to the end that a list of projects of outstanding importance may be formulated.

The Committee recommends to the Association that hereafter applications for membership shall be accompanied by a check for the first year's dues and for subscription to the JOURNAL.

The Committee recommends that permission be granted the Editorial Board of the Journal to designate a Circulation Agent.

The Committee recommends adoption of the following Resolutions proposed by a Conference called by the National Research Council, Division of Biology and Agriculture:

Resolved

1. That it is the sense of this conference that an inter-society conference should be raised to study and report upon the feasibility of federation of the biological societies and to develop plans for the said federation.
2. That for the purpose of effecting such an organization, each society, and Sections F & G of the American Association for the Advancement of Science be requested to designate its President and Secretary as members of an inter-society council which shall be authorized (1) to deal with all matters of common interest such as pooling of programs that are consistent with the existing regulations of the constituent societies; and (2) to draw up proposals for a constitution and by-laws of a federation of the societies in question, and to present them for action at the next annual meeting.

Although no formal action was taken, it was understood that the conference raised by the adhering societies should be empowered to invite other organizations to join it later.

MR. W. C. O'KANE: This report involves consideration by the Association of several specific recommendations. I will read them one at a time for action by the Association.

First, the Committee recommends that a symposium be held in next year's program on the subject of "Standards for the Training of Men Who are to enter Professional Entomology."

Voted that this recommendation be adopted.

Second, the Committee recommends that hereafter applications for

membership shall be accompanied by a check for the first year's dues and for subscription to the JOURNAL.

Voted that the recommendation be adopted.

Third, The Committee recommends that permission be granted the Editorial Board of the JOURNAL to designate a circulation agent.

MR. GLENN W. HERRICK: What does the Committee mean by "circulation agent?"

MR. W. C. O'KANE: There are doubtless many libraries and individuals who would like to subscribe for the JOURNAL, and the idea is for the Editorial Board to find some member who is willing to give some time to correspondence and act as a circulation agent for the JOURNAL with the intent of enlisting the help of the various entomologists to secure additional subscriptions. This agent would, of course, serve without pay.

MR. E. P. FELT: The JOURNALl can be furnished to additional subscribers at very small cost to the management, and the amount secured will enable the JOURNAL to publish more matter.

MR. W. C. O'KANE: One hundred additional subscriptions would make a difference in the financial status of the JOURNAL at the end of the year, and two or three hundred would possibly mean a larger JOURNAL. It is necessary to follow this matter up closely if the subscription list is to be increased.

MR. GLENN W. HERRICK: What proportion of our membership subscribes to the JOURNAL?

SECRETARY A. F. BURGESS: About 80% of the members are subscribers.

Voted that the recommendation be adopted.

Fourth, the Committee recommends the adoption of the resolution proposed by the conference called by the Division of Biology of the National Research Council, authorizing our President and Secretary to represent us at a conference which will attempt to draw up plans for a federation of biological societies.

MR. T. J. HEADLEE: May I ask for a statement of the anticipated advantages of such an organization?

PRESIDENT GEORGE A. DEAN: Is our representative on the National Research Council here?

MR. P. J. PARROTT: We believe there are some important matters of great interest to all scientific workers that cannot be handled by the individual societies. European work is greatly demoralized on account of finances. One of the objects sought to accomplish is to obtain money by which American Zoologists and Biologists would control their own literature. By an organization of this character, it is hoped to arrange in advance of the annual meetings for a conference of the

Secretaries of the Societies to avoid conflicts in programs and arrange symposiums which are of interest to all. These are the principal items. We are asked to send representatives to this conference to see if we cannot make arrangements along these lines. It does not bind us to anything.

Voted that the recommendation be adopted.

The report of the Committee on Policy was then adopted as a whole.

PRESIDENT GEORGE A. DEAN: Mr. Ball has a cablegram from Holland which I will ask him to read at this time.

MR. E. D. BALL: The following cablegram has been received from Holland addressed to the plant pathologists: "If American and Canadian Plant Pathologists and Entomologists be invited to join trip to Holland and conference, Wageningen, May, 1922, will some of them come? Please cable if possible. Merry Christmas."

"(Signed) QUANJER,
VAN POETEREN,
WESTERDYK."

This is an invitation to an international meeting in Holland. It will probably be a potato conference, as these three men are especially interested in potatoes. It may be possible for the government to send one man over at that time.

FINAL BUSINESS

The final business was transacted Saturday afternoon, December 31st.

PRESIDENT GEORGE A. DEAN: The first item is the report of the Auditing Committee.

REPORT OF THE AUDITING COMMITTEE

Toronto, Canada
Dec. 31, 1921.

The Committee has examined the books and vouchers of the secretary and have found them to be correct.

GLENN W. HERRICK
S. B. FRACKER
Committee

Voted that the report be accepted.

PRESIDENT GEORGE A. DEAN: Next is the report of the Committee on Resolutions.

REPORT OF COMMITTEE ON RESOLUTIONS

1. *Resolved,* That the American Association of Economic Entomologists heartily endorse the Insect Pest Survey and express its deep appreciation of the facilities

furnished by the United States Bureau of Entomology and the excellent services of J. A. Hyslop in organizing and conducting the initial work.

It is our opinion that the Insect Pest Survey is of great economic importance to present day and future entomology and that it is not only a privilege but the duty of every entomologist to coöperate with the observers responsible for the individual state reports and that the state reporters should realize the double responsibility placed upon them and that each one should make his reports complete and submit them promptly.

We would urge that the Insect Pest Survey be furnished expert assistance and that those responsible for its development further investigate the uses and needs of this service to the end that the correlation and interpretation of the data thus secured may be used in a study of the underlying principles involved in periodic or spasmodic insect outbreaks.

In view of the permanent value of the annual Insect Pest Survey summaries, it is strongly urged that these summaries be printed and made available.

2. *Resolved*, That this association express its appreciation of the valuable services rendered through the *Journal of Agricultural Research* and the *Experiment Station Record* and urge that funds be made available at the earliest possible date to resume publication of these two Journals.

3. *Resolved*, That the American Association of Economic Entomologists urge further and more complete coöperation between the Federal and state entomologists, between entomologists in neighboring states and between those of the United States and Canada, as suggested so clearly and forcibly by President Dean in his annual address.

4. *Resolved*, That it is the sense of this association that further and more extensive studies on insecticides and fungicides are needed and that in this connection it is highly important that chemists who can give their entire time to the chemistry of insecticides and fungicides be employed to work in coöperation with entomologists and pathologists.

5. *Resolved*, That, inasmuch as the literature dealing with insect pests of greenhouse and flower garden plants is widely scattered and that there is need of gathering together this information for use of florists and entomologists, and further that since such a compilation will, we believe, directly stimulate the study of greenhouse insect pests and in this way be of additional value to American florists, that this association indorse the Greenhouse Insect Index (prepared by J. J. Davis) and suggest that the Society of American Florists undertake its publication.

6. It is recommended that the President of our Association appoint the Committee on Resolutions at least a month previous to the date of meeting in order that a more careful study and organization of the problems to be considered by that committee may be made.

7. *Resolved*, That the American Association of Economic Entomologists express its great thanks and appreciation to the authorities of the University of Toronto, the Royal Canadian Institute and the Provinical Government of Ontario for the opportunity of holding its meetings at the University and also for other privileges and entertainment enjoyed through their courtesy.

Respectfully submitted,
John J. Davis,
M. C. Tanquary,
L. Caesar.
Committee.

After slight changes had been made in phraseology at the suggestion

of Dr. Howard and W. C. O'Kane, the resolutions were adopted by vote of the association.

PRESIDENT GEORGE A. DEAN: We will now hear the report of the Committee on Membership.

REPORT OF COMMITTEE ON MEMBERSHIP

The committee on membership submits the following report, and recommends for election to associate membership:

Batchelder, Charles Howard, 38 N. Main St., Orono, Maine.
Bedford, Theo., Wellcome Tropical Research Laboratories, Khartoum, Sudan
Borodin, Demetrius N., Room 1009, 709 Sixth Ave., New York City.
Brannon, Clarence, H., Greenville, Miss.
Bradley, George H., Mound Laboratory, Mound, La.
Broadbent, Bessie M., 1812 Ingleside Terrace, Washington, D. C.
Butcher, Fred D., Ames, Iowa.
Compton, C. S., Natural History Building, Urbana, Ill.
Dodds, Clifford T., 2344 Eunice St., Berkeley, Calif.
Doucette, Charles Felix, Doylestown, Pa.
Douglass, James R., 6427 First Ave., Birmingham, Ala.
Downes, W., Dominion Entomological Laboratory, Victoria, B. C.
Dye, H. W., Bailey Hall, Ithaca, N. Y.
English, Lester L., 6427 First Ave., Birmingham, Ala.
Harwood, R. W., Natural History Building Urbana, Ill.
Hoke, Gladys, Agricultural College, Miss.
Frison, Theodore Henry, Box 69, Riverton, N. J.
Glick, Perry A., 605 E. Daniel St., Champaign, Ill.
Griswold, Grace Hall, 126 Roberts Place, Ithaca, N. Y.
Hambleton, James T., 423 Dorset Ave., Chevy Chase, Washington, D. C.
Horton, Harvey A., Eagle Pass, Texas.
Keler, Stefan, Lemberg, Tarnowskiego 45, Poland.
Lancaster, Herman B., 6427 First Ave., Birmingham, Ala.
Lowry, Philip R., Durham, N. H.
McEvilly, J. E., Box 1, Agricultural College, Miss.
Mote, Don. C., Box 348, Phoenix, Ariz.
Nolan, Willis J., 423 Dorset Ave., Chevy Chase, Washington, D. C.
Pack, Herbert J., Utah Agricultural College, Logan, Utah.
Phipps, Clarence R., Experiment Station, Mountain Grove, Mo.
Readeo, Phillip, Lawrence, Kan.
Riley, George E., Agricultural College, Miss.
Smith, George E., Albion, N. Y.
Spessard, Lester Lewis, 1624 P St., N. W. Washington, D. C.
Thomas, C. A., Bustleton, Pa.
Watson, J. R., Gainesville, Fla.
Worthley, Harlan N., Dept. of Entomology, M. A. C., Amherst, Mass.

For transfer from associate to active membership:

Ackerman, A. J.
Barber, G. W.
Beyer, A. H.
Bilsing, S. W.
De Ong, E. R.
Dusham, E. H.
Graham, Samuel A.
Guyton, Thomas L.
Hartzell, Albert
Kisliuk, Jr., Max

Morse, A. P.
Poos, F. W.
Smith, Roger C.
Snapp, Oliver I.
Stear, J. R.
Thomas, Frank L.
Turner, William F.
Wade, Joe S.
Worthley, L. H.

The committee recommends that the resignation of the following members be accepted:

Bailey, J. W.
Blakeslee, E. B.
Cushman, R. A.
Gray, George P
Ham, W. T.
Rane, F. W.
Schalck, E. N.
Wood, E. G.

and that the 9 active and 17 associate members who are in arrears for dues for two years and the 10 members elected last year who have paid no dues, be notified by the Secretary that if the amount due the association is not paid within 60 days from the date of notice that they will be dropped from the roll for non-payment of dues.

Respectfully submitted,
E. R. SASSCER,
A. G. RUGGLES,
J. S. HOUSER.
Committee

Voted that the report be accepted and the recommendations adopted.

PRESIDENT GEORGE A. DEAN: Are there other reports?

DR. L. O. HOWARD: I wish to present the report of the Advisory Committee for the JOURNAL.

REPORT OF ADVISORY COMMITTEE

The members of the JOURNAL Advisory Committee in attendance today, met and unanimously recommend for officers of the JOURNAL

Dr. E. P. Felt, as Editor
Dr. W. E. Britton, as Associate Editor
Mr. A. F. Burgess, as Business Manager

R. W. HARNED
H. A. GOSSARD
L. O. HOWARD

Voted that the men nominated by the Advisory Committee be elected officers of the JOURNAL.

PRESIDENT GEORGE A. DEAN: We will now hear the report of the Committee on Nominations.

REPORT OF THE NOMINATING COMMITTEE

For President, J. G. Sanders.
First Vice-President, J. M. Swaine.
Second Vice-President, A. L. Lovett.
Third Vice-President, R. W. Harned.
Fourth Vice-President, M. C. Tanquary.
Committee on Policy, P. J. Parrott.

Committee on Membership, George G. Ainslie.

Committee on U. S. National Museum, E. P. Felt.

Representative National Research Council, George A. Dean.

Councillors for American Association for the Advancement of Science, T. J. Headlee, L. O. Howard.

Trustee Crop Protection Institute, W. E. Britton.

Advisory Committee, Arthur Gibson, R. A. Cooley.

Respectfully submitted,
ARTHUR GIBSON,
GEORGE G. AINSLIE,
C. L. METCALF.
Committee.

Voted that the report be accepted and the Secretary be instructed to cast one ballot for each nominee. The ballots were cast and the members named were declared elected. At the request of President Dean, Past Presidents Howard and Osborn conducted President-elect Sanders to the Chair.

After signing a Past President diploma and presenting it to President Dean, President-elect Sanders addressed the association, expressing his appreciation of the honor that had been conferred upon him and pledging his best efforts to the association for the coming year.

President Dean presented to President-elect Sanders the gavel of the association to be placed in his keeping for the coming year.

Secretary Burgess stated that he had held a conference with the officers of the American Phytopathological Society and arrangements had been made to hold a joint session next year. The subject to be discussed had not been decided, but it was requested that the members of each association send any suggestion they might have along this line to the Secretary of their Association. This should be done as soon as possible, as speakers should be selected by the first of April in order that they might have ample time to prepare their papers for the meeting.

He also read the following communication in regard to extension work which was signed by E. G. Kelly and W. P. Flint:

"A meeting of members of this association interested in extension work was held at the Prince George Hotel the evening of Dec. 29, 1921.

After a general discussion of subjects pertaining to extension work, an informal organization was formed for the purpose of holding an annual conference in connection with the meeting of the American Association of Economic Entomologists."

Announcement of the conference will be made during the first session of the meeting at Boston.

Mr. E. P. FELT stated that the matter of handling the manuscripts submitted to the JOURNAL was becoming increasingly difficult, particularly on account of the fact that many publications handling short papers had been or were being discontinued. He presented the following statement which had been reviewed and had the endorsement of both the Advisory and Editorial Boards of the JOURNAL.

JOURNAL OF ECONOMIC ENTOMOLOGY SUMMARY

Membership of Association 667, of which 49 are foreign.

Number of subscribers, 896.

Average cost per page of printing JOURNAL in 1914, \$2.24, in 1920, \$4.79, in 1921, about 10% higher than last year.

January 1, 1920, the subscription price was increased by \$1.00, or 66⅔% for members and 40% for non members.

The increased cost of publication since 1915 amounts to over 114%.

The JOURNAL is the official organ of the Association and as such should serve the best interests of the entire membership. The official proceedings rightly have precedence. The inclusion in the official proceedings of papers read by title gives them precedence over others, sometimes more important ones, which may have been in the hands of the editor months earlier. Papers read by title now occupy a considerable part of the proceedings.

The constant increase in the volume of the matter submitted for publication has necessitated progressive restrictions to keep within our means. It is essentially a financial problem. Authors have been advised from time to time that contributions were too lengthy for available space and at our last meeting a maximum limit of 2500 words was established for the purpose of giving a better opportunity for the independently submitted manuscript. Even this does not make it possible to print one such paper annually from each member, a total, if this were done, of 3000 pages as compared with the usual 500 or less.

There have been submitted to the editor within the last few years, papers which would make nearly 20 printed pages, sometimes with considerable tabular matter or a rather large series of illustrations—both much more costly than ordinary text.

It is impossible to print all papers which may be offered unless resources are greatly increased, possibly seven to ten fold and even then restrictions would be necessary. Many other scientific publications are in about the same predicament. High prices and unusual limitations in many directions explain the situation.

Additional funds may be secured by increasing the subscription rate, getting more subscribers or securing funds from some outside agency.

A raise in the price of the JOURNAL may be offset in large measure by a reduction in the number of subscribers. It could not become effective until 1923.

In spite of the technical nature of the JOURNAL it is possible to considerably increase the number of subscribers, each additional subscription increases actual cost about 20% and permits the turning back into the JOURNAL of about 80%.

Outside sources are more easily discussed than discovered. Most feel that the JOURNAL should be self supporting. It has been the Association method of doing business.

Increases in the advertising matter would assist materially and might bring some most unwelcome complications. The limited circulation and the few direct sales resulting are obstacles not easily overcome.

The managers of the JOURNAL keenly appreciate the need of larger publication facilities and would welcome suggestions for bettering conditions. It is felt that the worst has passed. A gradual change for the better is expected soon.

In view of the above, it is considered advisable to limit the official proceedings to papers actually read at the meetings, to allow the length of papers to remain at a maximum of 2500 words, to suggest to authors continued conciseness in text and careful discrimination in the use of the more costly tables and illustrations, and to urge upon every member and well wisher of economic entomology a general and

earnest effort to increase the number of subscribers and thus secure at once more funds which will be used to enlarge the JOURNAL and then it in turn can render better service to its widely distributed subscribers.

Voted that the statement be accepted and the recommendations contained therein be adopted.

Mr. T. J. HEADLEE inquired as to the cost per page of printing the JOURNAL, and upon being advised that it averaged about $5.00 provided very little tabular matter was used, stated that he believed it would be practical to publish papers from individuals or institutions provided they were willing to pay the cost, they to receive a certain number of separates. He thought this would offer an opportunity for publishing more matter in the JOURNAL.

Mr. E. P. FELT stated that the management had never refused to publish a paper if the author wished to pay the cost, but felt that care should be taken not to discriminate against any member by compelling him to make payment. He expressed his approval of the idea suggested by Dr. Headlee.

Mr. W. C. O'KANE stated that many institutions with which entomologists were connected were financially able to pay for the publication of short articles, and he believed that they be urged to do so.

Mr. E. P. FELT stated that if articles were paid for, they could be printed with less delay, and Mr. OSBORN suggested that the Editor should have authority to exercise his judgment as to whether a paper was suitable regardless of whether it was to be paid for or not.

Mr. T. J. HEADLEE stated that the plan should be handled so as to avoid any suspicion of discrimination among the members.

Mr. Z. P. METCALF believed that there were a good many cases where either the authors or the institution with which they are connected would be very willing to pay for publishing short articles, and that he was satisfied that they could be published cheaper than if issued separately.

Mr. L. M. PEAIRS remarked that the institution should pay a definite amount for separates which would cover the cost of both publication in the JOURNAL and the separates. This would simplify bookkeeping and would, he believed, cost the stations less than they were now paying for small publications.

In reply to a question by Mr. T. H. Parks as to whether a 2500 word limit would be enforced if an institution paid the cost of publication, Mr. FELT stated that he saw no advantage in enforcing the rule in a case of this kind, or in the case of a member who preferred to pay for matter overrunning the present maximum if reasonable limits were observed.

It was voted that the early publication of articles approved by the Editor be permitted, if the cost is paid by the writer or institution with

which he is connected, and that men contributing papers to the JOURNAL be urged to secure permission when possible to publish articles under these conditions.

PRESIDENT GEORGE A. DEAN: The Executive Committee has authorized the Secretary to transfer the $100 Liberty Bond and $500 from the association fund to the permanent fund.

Is there any other business?

SECRETARY A. F. BURGESS: I move that the next meeting of the association be held at the same time and place as that of the American Association for the Advancement of Science.

The motion was carried.

Dr. L. O. HOWARD: The next meeting of the association will be in Boston, followed by a meeting in Cincinnati and Washington. After that, there will probably be a meeting in the West, but the place has not been definitely decided.

SECRETARY A. F. BURGESS stated that as Christmas would come on Monday in 1922, it would be more difficult than usual to arrange the program. He stated that he had had a conference with the Secretary of the Entomological Society of America and a plan was being considered of holding one session of the meeting of that society during the time when one of the sessions of the association was being carried on. Of course, the programs would have to be arranged so that unrelated subjects would be considered at these sessions. The suggestion was made in order to see how a plan of this sort would work out. No objections being offered, attempt will be made to put it into operation.

Mr. WILLIAM MOORE suggested that less than 50% of the members were present at the business session, and that it would seem desirable to change the business meeting to the morning instead of the afternoon session on the last day of meeting.

SECRETARY A. F. BURGESS stated that the by-laws provided that the final business shall be transacted at the last session, but that the by-laws could be amended by a notice in writing prior to the time of the next annual meeting.

Mr. E. P. FELT: I would like to announce at this time that it has been decided to establish several small departments in the JOURNAL, one each for Horticultural Inspection, Apiculture, and for the Pacific Slope Branch, and possibly another department covering new insecticides, if some one can be secured to handle the matter that should be published. The idea is to increase local interest in the JOURNAL and make it more valuable to its readers. The plan will be tried in a modest way at first, and the co-operation of all is desired in order to make it a success. It is expected that the Secretaries of the Sections and of the Pacific Slope Branch will take care of the matter to be used in their departments.

PRESIDENT GEORGE A. DEAN: As this meeting draws to a close, allow me to express my appreciation of the honor you have shown me in selecting me to serve as President of the American Association of Economic Entomologists. I have deeply enjoyed whatever service I have given during the past year, and I wish to thank the members of the Association, particularly the committees, for their fine spirit of endeavor toward the accomplishment of constructive work. I cannot permit this meeting to close without expressing my heartfelt appreciation of the faithful and splendid services of our Secretary, Mr. Burgess.

Dr. L. O. HOWARD: Without addressing the Chair, I wish to propose a motion that the Association heartily thanks Professor Dean for his tactful, intelligent and very efficient administration during his term of office.

The motion was seconded and carried unanimously.

The meeting adjourned at 4.15 p.m.

ENTOMOLOGISTS' DINNER

The entomologists' dinner was held Friday, December 30, 1921, in the Banquet Hall of the Prince George Hotel, at 7.00 P. M.

President George A. Dean presided.

At the close of the dinner, President Dean introduced Dr. W. E. Britton as Toastmaster of the evening, as follows:

This splendid gathering this evening of nearly one hundred forty has certainly dispelled any doubt that may have been in the minds of the committee as to the desirability of continuing the Entomologists' dinner.

The committee has selected for toastmaster one of the past presidents of the Association, who has not only contributed much to our entomological science, but also one who has exerted a splendid influence toward the accomplishment of a fine spirit of harmony and a bond of friendship among the members of the Association. I take pleasure at this time in introducing as our toastmaster, Dr. W. E. Britton, State Entomologist of Connecticut.

TOASTMASTER W. E. BRITTON: Mr. President, Fellow Entomologists and Friends: This is an interesting meeting in a good many ways. It is a sort of anniversary of the founding of this Association, which started then in a small way and now has a membership of over six hundred. It is also an anniversary of the Entomological Society of Ontario. It is also interesting because some of us have left our native country and crossed the line to meet with neighbors. To be sure, we didn't notice the line when we crossed it, and shouldn't have known much about it except for the customs official.

Entomologists in their training and development are something like insects. They pass through certain stages. Now some of them have striking and complete transformations. With others the development goes on more slowly and takes place in an inconspicuous and obscure manner. With some we may say that the transformation is incomplete. I might go further and say that some of them never reach the adult stage. Now we have as speakers to-night quite a number who emerged as adults sometime ago. Some of you, of course, are only second stage nymphs. (Laughter)

Before we begin the program of the evening I wish to refer to that summer meeting that we had last July. We had a very interesting two days' meeting in Eastern Massachusetts, and we saw many things of entomological interest, but the one thing that stands out in my mind above all others, and will, as long as I remember anything, was the ball game that we had just before dinner. We had reached Bass Point, Nahant, where we were to spend the night. Dinner was not ready and our genial secretary came around with a baseball bat in hand. He said if he could find a ball, we would have a game. Pretty soon he came out with a tennis ball. He picked Messrs. Worthley and Headlee as being the two fat men of the party, and they had to choose sides to play the game. So Worthley chose Government men and Headlee chose State men. Now the first man who went into the box to pitch for the State men was Professor Parrott. (Applause) He is the Ty Cobb of the Entomologists. He pitched two innings I think, and then Dr. Headlee went into the box—and he was the Babe Ruth! You ought to have seen the fun that we had!

Dr. Headlee's assistant, Dr. Peterson, was the catcher, and Dr. Headlee used all the speed at his command. He was a little wild and a little out of practice, and the spectators thought at first that he was trying to kill his assistant. Very soon they thought he was trying to kill off the Government men who came to bat. I can't tell you the score, but we had a lot of fun and we have felt better for it ever since. If there is any controversy between our Canadian friends and the entomologists from the States, I think we had better settle it by playing a baseball game.

I have here a letter from Professor C. W. Hargitt written to Dr. Felt, and I wish to read it to you.

SYRACUSE, N. Y.
Dec. 22,'21

Dear Dr. Felt:

Appropos of the meetings of the Economic Entomologists at Toronto next week, and the proposed reunion of the Charter members of that Association at which I was invited by the President, Professor Dean, to make a brief talk, I regret that circumstances which have just culminated may prevent my attendance,

tho it may be possible to get there. I feel it incumbent however, to make this statement to you in order that you may communicate the reason of my absence should I fail to appear.

From the time of your first mention of plans to me last fall I looked forward with delightful anticipations to the opportunity of meeting and recounting some of the pleasantest of my scientific associations and friendships. Among entomologists were Comstock, Riley, Lintner, Bethune, Fletcher, Smith, Howard, Webster, and others whose friendship I greatly cherish.

Thanking you personally for having noted my name among those participating in the original meeting, and hoping yet that I may be able to join you at Toronto in this reunion, believe me,

Yours truly,
CHAS. W. HARGITT

Now some of you know, at least who will be one of the speakers on the program to-night, because it is a paper left over from one of the meetings, and the gentleman who is to give it needs no introduction to you. However, I am going to introduce him. I have known Dr. Howard for some twenty-five years and we have always gotten along very well together. We have nearly always agreed, but there have been a few times when we disagreed. And when he gets as many gray hairs in his head as I have, then he will see wherein he was wrong. (Laughter)

Dr. Howard has built up a large organization of entomologists, the largest in the world, I think. I never knew how he managed to do it and get along with all these fellows, but I suspect that it is because he calculates the ecological relationships between his various men, not by the slide rule but by the golden rule. Dr. Howard. (Applause)

DR. L. O. HOWARD: Dr. Britton doesn't know whether, if I had any hair, it would be gray or black or red! (Laughter) I'll tell you a secret though: When Einstein came to Washington this spring and exhibited that big head of hair, I was strongly tempted to let my hair grow again; but my wife dissuaded me!

I am right in the middle of my cigar and I feel about like Professor Bateson did at the Naturalists' Dinner last night. Bateson's cigar went out while he was making his address, and he stopped the speech until he lighted it again. One of the men met him at luncheon today, and suggested that he was hard at work on an invention whereby a man could speak and smoke at the same time. Bateson was greatly interested and said, "What an extraordinary people you are!" (Laughter)

This ought to be an occasion for joyous speech such as the Toastmaster has given you, and to take an adjourned paper from the morning session of yesterday and read it at this time would hardly seem quite right—but it is all right. There are good reasons for it. Very great things deserve treatment with circumstantiality of detail. Daniel Defoe's story of the great plague in London, and Pepys' Diary, are full of details, but they relate to an extremely interesting event and period. Now this is a paper of details, but refers to an extraordinary

organization—The Association of Economic Entomologists. This is its beginning. It grew from a little bit of a thing. Therefore these details should be interesting. Of course a great many of you are not at all interested, but after what I have just said you are obliged to be interested.

THE ORGANIZATION MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS AT TORONTO, AUGUST, 1889

By L. O. Howard, *Washington, D. C.*

On the 1st of November, Doctor Felt wrote me suggesting that a brief note concerning the organization of this Association could appropriately be presented at this present meeting, since the organization occurred at this place, and since in the interval of more than thirty-two years the Association has not met here.

The idea of such an association as ours was first suggested in an editorial note in *Insect Life* in January, 1889. I am not quite clear as to who wrote the note, although I judge, from certain peculiarities of construction, that it was Professor Riley. At all events, the idea of forming such an association was surely his. In this preliminary note, he asked for the opinions of different entomologists, and a month later published extracts from letters from Prof. A. J. Cook and Professor Osborn endorsing the idea. Later, letters were received from T. D. A. Cockerell and a few others.

Professor Riley went to Europe in the late spring and remained abroad until the following October, and during his absence the organization was effected.

In anticipation of the coming Toronto meeting, James Fletcher of Ottawa had been made President of the Entomological Club of the American Association for the Advancement of Science. On May 23d, I wrote Fletcher as follows:

"About the proposed entomologists union: Prof. Riley, in making the proposition, put it out as a tentative wording of an idea he had long entertained and which we have often discussed; his object being to see how the idea would be received. We have been much disappointed with the result, and if it has met with general favor most entomologists have kept their opinions to themselves in spite of the fact that we plainly asked for a general expression of opinion. The result at which I have arrived in my own mind is that on the whole the actual workers are lukewarm and that perhaps the idea has been broached too soon * * * I should like very much to see the question brought up at Toronto and thoroughly discussed and perhaps a committee appointed to draft a plan of organization."

On June 17th I wrote Fletcher again—

"I have just received a letter from Professor Riley, who is of the opinion that it will be better for you to make the call as President of the Entomological Club and to go ahead under that call and organize at the forthcoming meeting of the American Association. He thinks that it will be better to confine the association to

the working, practical economic entomologists, as there is hardly any necessity for a national association of any other kind. He suggests that when you come to Washington you and I together should draw up a constitution and by-laws and set forth the objects of the association."

The following month Fletcher came to Washington and spent some time with me. Together we drafted the original constitution as published in *Insect Life* for September, 1889, pages 87–88, and during his visit Fletcher wrote the interesting article entitled "Preliminary Note upon *Chionobas* (*Oeneis*) *macounii* Edw.," and Miss Sullivan made the excellent illustration accompanying the note, which is published on page 45 of Volume II of *Insect Life*. I myself was busy in preparing the article on a newly imported elm insect (*Gossyparia ulmi* Geoff.) published upon pages 34–41 of the same number.

It was Fletcher's first visit to Washington, and we had a delightful time together. He was enormously interested in everything—insects, trees, plants, niggers—his interest and enthusiasm were absolutely catholic. We were in the middle of the horn-fly investigation at the time, and he took a trip into Virginia with me to study this insect and experienced for the first time the July heat of Warrenton, which, however, in no way lessened his energy and enthusiasm.

Immediately after his departure I wrote to twenty-seven of the leading economic entomologists of the country, at follows:

Dear..........:—I send you enclosed a circular just issued by Mr. James Fletcher, Entomologist and Botanist of the Central Farms at Ottawa, and President of the Entomological club of the American Association for the Advancement of Science, who has just visited Washington. If you can possibly attend this meeting, I would earnestly urge you to do so, and if you cannot attend please address a letter either to Mr. Fletcher at Ottawa or to myself before August 22d giving us the benefit of your ideas and stating further, if such an association is organized, you will consent to take an active part in it hereafter.

With this letter, I enclosed a copy of the draft of the proposed constitution to Professor Forbes, to Professor Comstock, and to Doctor Lintner.

The Toronto meeting of the American Association in August, 1889, was a great success. The Entomological Club of the Association held a very interesting meeting, but the organization meeting of the Economic Entomologists was attended by only nine of us, namely Prof. A. J. Cook, who acted as Chairman, Dr. John B. Smith, who was Secretary, Dr. C. J. S. Bethune, Mr. James Fletcher, Mr. E. Baynes Reed, Mr. H. H. Lyman, Prof. C. W. Hargitt, Mr. E. P. Thompson, and the writer. The meeting was held at Scarborough Heights, a wooded knoll on the shore of Lake Ontario, the afternoon having been devoted by the zoologists and botanists of the American Association to a collecting expedition.

In my address as President of the A. E. E., delivered at Brooklyn August 14, 1894, I made a brief mention of this organization meeting

and indicated that the name adopted was *The Association of Official Economic Entomologists*, which was altered at the first annual meting, held in Washington in November of the same year, to read *The Association of Economic Entomologists*. Analyzing the official status of the men at the organization meeting, and those at the Washington meeting, and those at the Brooklyn meeting five years later, I stated that I had introduced these brief historical data in my presidential address for the purpose of showing the interesting paradox that this Association was originally made official by non-officials, that it was subsequently made non-official by officials, and that since it was made non-official it had become more official than before.

As this is simply a historical note suggested by our present place of meeting, it would hardly be appropriate to make further comments; yet I cannot refrain from stating that in the tremendous advance of economic entomology in the United States this Association has played a most important part and that its influence has been felt all over the civilized world.

What precedes was written mainly from memory, and what I have said about the organization meeting corresponds to the introduction to my address in 1894; but after this was written I consulted the account as given in the *Canadian Entomologist* for September, 1889, pages 166 to 168, and find that there was a meeting August 28th (the day before the meeting at Scarborough Heights August 29th) of a committee of organization, and that those present who signed the constitution on the 29th included, besides those mentioned (with the exception of Mr. E. P. Thompson), C. M. Weed and H. Garman. Weed and Garman were undoubtedly present the day before, but my memory fails me as to their presence on August 29th, and indeed I failed to record them when I wrote the paragraph in the presidential address in 1894, only five years after the event.

All of the persons present at the organization meeting of the Association of Economic Entomologists were readily accounted for, with the exception of E. P. Thompson. I knew about him in August 1888, but what I knew had been lost from my mind in the intervening years. For the purposes of this reminiscential sketch, it became very desirable to find out something about him. I first consulted the indices of *Insect Life*, to find if he had written anything entomological about that time, but without result. Then I consulted the Bibliography of American Entomology, no result. I then consulted the correspondence files of the Bureau of Entomology for the years 1885 to to 1890, again without result. Then I looked at the list of members of the American Association for the Advancement of Science for the year 1888, and found E. P. Thompson, of Beaver Falls, Pa., entered as

belonging to Section A (Mathematics and Astronomy). But why would a mathematician be found attending this organization meeting? In great doubt, and without any especial hope of success, I consulted the last edition of Professor Cattell's invaluable "Men of Science," and there I found "Edward Payson Thompson, Mathematician, Riverside, Calif." The very brief notice indicates that he was Professor of Mathematics at Geneva, Pa. 1880 to 1890, and of Mathematics and Chemistry, Westminster, Pa. '91 to '93. Incidentally, he was a member of the International Congress of Mathematics at Paris in 1900. Nowhere in the sketch was it indicated that he lived at Beaver Falls, Pa. in 1888; so he might or might not be the same man—probably not. Then I looked up the old United States Postal Guides, and found that Geneva, Pa., where he was teaching at that time, is in Beaver County and that mail for Geneva was to be addressed to Beaver Falls. This rendered the identification very probable, and I wrote to Professor Thompson at Riverside, and in due time received the following reply:

142 Linden Street, Riverside, Calif.
Nov. 29, '21

Professor L. O. HOWARD, Bureau of Entomology:
Dear Sir:

Your interesting note regarding the organization meeting of the Association of Economic Entomologists is at hand. The record is correct, and in one sense I just happened to join the group; and in another, I was interested in the subject, and expected to follow it up, and have always been interested in it, but have not had the opportunity to be directly connected with it. I remember with interest yourself, and Professor Hargitt, and I think Professor Smith of Rutgers, and on one of the excursions I remember a lady, perhaps Mrs. Professor Woodward, who may not have been at the organization meeting. I was then young and felt a little out of place, but my interest and expectations were real, and it is a pleasure now to look back at that and some other early experiences. My principal study was Mathematics. I am now 63. I taught Mathematics for 24 years, and then came out to California, where my chief interest is in the orange grove, where of course the subject of Economic Entomology is of considerable practical importance.

I feel proud of the success of our Society, and not ashamed of having been in at the founding of it.

Incidentally, I used to be in the church at RockIsland, Ill. of which Secretary Wallace's father was pastor, and I have a recollection of passing the house on the way to school where Professor Riley the entomologist lived.

I remember you very well, and have seen you since at some public Association meetings.

With best regards yours,
EDWARD PAYSON THOMPSON

Dr. Howard interpolated statements as follows:

(1) Here is a little incident that has never been recorded. There was a Coast and Geodetic Survey man who stayed with me one night when Fletcher was there. Well, Fletcher and I got home just at dark. We went into the kitchen to get a glass of water and found a Scutigera running around catching flies. Fletcher had never seen a Scutigera, so he took it and put it in a glass on the sideboard. Then we went into the other room and sat there. We didn't turn up the light because it was too hot.

Then Bird came in, the Coast and Geodetic Survey man. He wanted a glass of water. Well, he got hold of this tumbler containing the Scutigera, poured water into the tumbler and drank the contents—Scutigera and all. We managed to keep him from strangling! Then he took a train for the West, and I didn't see him for years. But one day he turned up in Washington, and I said to him, "Did you ever have any bad effects from that centipede?"

He said, "Well no; but look here, Howard, I spit legs for a month!" (Laughter) (2) So you see I was one of the fathers of this great, big splendid group of children. I am proud of it. They, by the way, had no scientific mothers. It is a new kind of parthenogenesis, for which Professor O'Kane has suggested the name patergenesis. (Laughter) But there have been daughters though no mothers, and some of them have distinctly arrived. Witness Dr. Edith Patch and Miss Annette Braun over there!

Thank you. (Extended applause)

Toastmaster W. E. Britton: Since those days much more attention has been paid to entomology and more people know about it than in the olden times. Even our newspapers are noticing things entomological. In the old days they used to make all manner of fun of them. Of course they do some, now. I have some clippings here. One quotes from the report of the Connecticut Agricultural Experiemnt Station. It says, "Mr. Champlain reared four hymenopterous parasites of the genus *Pezomachus* and an undescribed Buprestid beetle of the genus *Agrilus* from galls on hop hornbeam. This should be a warning to drinkers." (Laughter)

Here is another one from a newspaper far away. Some of you know that less than a year ago there was published a check-list of the insects of Connecticut. A friend of mine, a chemist who had gone from Connecticut to Minnesota, sent me a clipping from a local newspaper, headed "Boost Connecticut," which reads as follows: "Sir: There are some folks who just must air their hatreds. There is that fellow, for instance, who has recently published a 'check list of the insects of Connecticut'." (Laughter) As far as the author was concerned, it was a labor of love, and that is about all he got out of it. He never hated anybody—not even the insects. But I could not help thinking what a lot more hatred must be aired if somebody like Professor Ruggles should publish a check list of the insects of Minnesota! (Laughter)

We have with us tonight a man who has probably had more experience in training entomologists—at least he has been at it for a greater number of years—than any other man in this country. Professor Comstock began teaching in 1872. He has been at it ever since. He was Govern-

ment entomologist in the years of 1879 and 1880, returning to Cornell the following year. He has also published a number of books on butterflies and spiders and various other things.

Now, before we call on Professor Comstock I wish to say that he has trained a large number of men who have gone out to other places, and many of the men here tonight had their training under Professor Comstock. He has been very kind to come here tonight so that we can all see him, and I will ask you to stand and drink to the health of Professor Comstock.

The members arose and drank to the health of Professor Comstock. (Applause)

PROFESSOR J. H. COMSTOCK: Mr. Toastmaster, and Fellow Workers in Entomology: I feel that I have only a slight claim to this mark of appreciation from this society. A generation has come onto the stage since I stopped working especially on economic entomology and drifted off into another division of entomology, a generation that has put economic entomology into the proud place which it now holds. My withdrawal from this division of our work was not due to any loss of interest in it, nor to any lack of appreciation of its importance. It resulted merely from the fact that in the growth of our department at Ithaca it seemed advisable to have a division of labor, and I was very fortunate to be able to put the economic phase of the subject into the hands of Professor Slingerland. You will all agree with me that that was a fortunate appointment. You know the work of that brilliant worker. One of the things I cherish most is that I had a part to play in the development of that remarkable career, unfortunately so short.

Your President, when he wrote asking me to come, said that he wished me to make a short speech of a reminiscent nature. So if I reminisce you mustn't blame it entirely on the peculiarities of old people who are apt to reminisce tiresomely, but rather on your President.

I want to tell you a word about Slingerland. Slingerland was a country boy. He came from the home town of Mrs. Comstock and she was interested in him. When he came to Cornell as a freshman the insectary had just been built, and I gave him a position as janitor in it because it was necessary for him to earn his way through college. During his freshman year he attended a course of lectures on general zoology, and at the end of the course I gave a lecture on the habits of insects, a single lecture, because the following term there was to be an extended course in entomology. Slingerland told Mrs. Comstock afterwards that that night he was unable to sleep. His mind was filled with the wonders of the insect world. He decided then that he would devote himself to the study of entomology. He also told her that when he came to Cornell he did not know that a butterfly came from a cater-

pillar. Starting from that zero point of knowledge, this man with untiring energy and devotion in the short period he was able to work (I forget just how long; but I think his working period was only seventeen years) made a worldwide reputation. You are familiar with his works. In our department we have a great accumulation of unpublished painstaking notes and photographs which are still a constant source of information.

It is a bromidic remark to say that we are living in an age of great development, but nevertheless it is true, and especially true of entomology. I think that the younger members of the society, the second stage nymphs (laughter) can not appreciate what a change there has been, in the memory of some of us who are here.

I am going to tell you a personal experience. It would be difficult to-day, I think, for you to find a young person interested in nature who does not know that there is such a science as entomology. But that was not so fifty years ago. A little over fifty years ago I became interested in botany. I was at that time studying in the winter at an academy, and sailing on the Great Lakes in the summer. I carried on my study of botany on the Great Lakes. You would not think that a very good place to study botany, but I had a tin box made—had never heard of a vasculum—and when we were in port I collected plants and put them in the box, closed it up tightly, and then when we got outside I analyzed the plants at my leisure. Of course the running down of a plant to its specific name was the botany of those days.

I soon became dissatisfied with that. I saw references in the back part of the book I was using to flowerless plants, and I wanted to learn something about them. So I started on the search for some book to help me. Nobody that I knew could tell me what to get, so each time that I was in port I hunted the book stores for a book on crytogamic botany. The clerks used to stare at this kid who was using words longer than he was, but one day in Buffalo I went into a book store and asked the clerk if they had any books on cryptogamic botany, and he said that if they had any they would be in the back part of their store. He took me back to a case where they had segregated their works on natural history, and I began to look for the desired book. I came upon a copy of Harris's "Insects Injurious to Vegetation." At that moment I learned that there were books written about insects. I had seen insects in my collecting that had interested me, but had no idea that anybody ever wrote about them. I took the book to the clerk and asked him the price. He said it was ten dollars. That was a good deal for a lad working for pretty small wages. I handed the book back to him sorrowfully and went back to the schooner, but I couldn't get that book out of my mind. The next morning I went to the captain

and drew ten dollars of my wages and went up and bought the book. I then made up my mind that I was going to study entomology.

This must be a short talk so I won't go into the details of my troubles, how I tried to kill the insects by burning matches under their noses, and so on. (Laughter)

Soon after, Cornell University opened, and in the first announcement of the University was a statement giving a list of the faculty, and then a list of professorships soon to be filled. One of them was a professor of entomology and lecturer on insects injurious to vegetation. I saw that that was the place for me to go, for I wanted to study under that professor.

I want to say in passing that the fact that that was announced as one of the professorships to be filled, is due to the broad vision of Andrew D. White, our first president. He had been a teacher of history and a diplomat abroad, but he had the breadth of view to see science coming, and he planned Cornell on lines by which scientific study was of equal recognition with the humanities. I think that he got the idea of the importance of entomology from the writings of Fitch. He had been in our State Senate, had been on the Committee on Education, and Dr. Fitch was then the Entomologist of New York State and the reports of Fitch doubtless came to his attention. At any rate, that was the announcement.

Well, the professorship of entomology was not filled until a good deal later. And very soon after I went to the University, in fact, in my Junior year there was established for me a little laboratory of entomology. It was in a room in our bell tower. You can imagine the size of the room. Among the students (a very small number) who took work in that laboratory, was L. O. Howard.

I was very anxious to learn how to do my work. Up to the time I was made instructor in entomology I had no assistance whatever in entomology. So I made a pilgrimage to Salem, N. Y., to visit Dr. Fitch. That stands out as one of the bright memories of my experience. I found him a very genial old gentleman. He was, as you know, a practicing physician, and like many country physicians, he had an office building out to one side in his yard, a little square building, and in that was a really remarkable entomological library. When I talked with him about methods and how to go to work, he said, "The way to do is to sit down and study an insect." That is what I got from him. But it has always been a blessed memory to have seen that grand old man.

About that time Dr. Wilder, who was my chief, and to whom I owed the opportunities that I had, arranged with Dr. Hagen that I might study with him. Agassiz had been anxious that Hagen should give

instruction. At first Dr. Hagen hesitated, and then he said he would be glad to give a course to one student. So I went on and spent the summer in the museum at Cambridge determining some insects that I carried on, and receiving instruction from Dr. Hagen.

Let me tell you what happened each morning: It was a hot summer. Dr. Hagen, as you will remember, was a stout gentleman. He would come in, in the morning, take off his coat and hang it up back of the door, take off his vest and put it on top of his coat. That left him in his shirt sleeves and trousers. Then he would take a pipe with a long, flexible stem, load the pipe, sit down at a little square table such as you will find in some students' rooms, put the pipe on the floor behind him, and with the mouthpiece in his mouth, he would say, "Now you come and I vill tell you some dings vat I know." Every morning throughout the summer that exact formula was used.

Then, with a pencil and some sheets of paper before him, which he used as a substitute for a blackboard, he gave me a lecture on insect morphology. I believe that must have been the first special course on insect morphology given on this side of the Atlantic. (Applause) And it was a wonderful course. Years afterwards when I gave a course of lectures on insect morphology myself, I would go back for data to my notes on these lectures.

I think that these few reminiscences will show you the growth that there has been, in the memory of some of us who are here. I will not tire you with more. (Extended applause)

Toastmaster W. E. Britton: We had fully expected to have with us to-night Dr. S. A. Forbes, who is probably the oldest living state entomologist in the country. He has been publishing reports for nearly forty years. As some of you know, Walsh was the first state entomologist of Illinois, followed by Le Baron, Thomas, and then by Forbes. This office was started very soon after that filled by Riley in Missouri, so that the set of Illinois reports is one of the very valuable ones and is necessary in the library of every economic entomologist. But for some reason or other, Dr. Forbes was not able to be present. He has been an investigator, teacher and director of the Natural History Survey of Illinois, and has a long series of reports to his credit. He is a man of splendid administrative ability, I wish that he might be here to give us a few words.

Of course, everything in entomology has developed so rapidly that we hardly know today what tomorrow may bring forth. After hearing the experience of dusting with the aeroplane, I see that we will have to change our old slogan "Let us spray," to that now used by the housewife, "Get up and dust." (Laughter)

Now we have present another man who has been long in the service and he is one of our greatest teachers. I refer to Professor Osborn. He has been teaching for forty years. He has also been an investigator. He has worked with injurious insects and has done systematic work on the Hemiptera, especially the leaf hoppers and the sucking lice. By the way, Professor Osborn, here is a newspaper clipping you may find of use. Somebody wrote to a newspaper and asked, "What is the cause of head lice?" The answer is this: "The same as the cause of goldfish and grizzly bears. Now they wait, then they mate, presently they propagate, two by two and eight by eight, or some such algebraic rate. In mathematics poorly bred, I can't keep such things in my head. The first pair? From some loving friend. And here my cootie tale must end." (Laughter)

Now Professor Osborn has sent out a large number of students who have occupied prominent places in entomology in the United States, Canada and in Africa—perhaps some other countries. I understand that there are one hundred or more engaged in professional entomological work. We would all be pleased to hear a few words from Professor Osborn (Applause)

Professor Herbert Osborn: Mr. Toastmaster, and Entomological Friends: it is a pleasure to address you, especially in such company as I have to-night. I might begin by going back to one of my entomological inquiries. I remember quite a number of years ago I had a letter from some anxious inquirer which read, "I wish you would tell me how to kill *aunts*. I have a lot in the cemetery." (Laughter)

Now the President wrote me a short time ago asking me to give some recollections of the early days of the society, and I thought that I might give you some features of the meetings that might interest you. I shall try to do it in a few words.

I did not attend the first meeting, the Toronto meeting here at the time of the organization, nor the meeting in Washington that shortly followed that, at the time of the meeting of the American Association of Agricultural Colleges and Experiment Stations. But the next year, at the Champaign, Illinois, meeting, I was present, and that we considered in many ways the opening meeting because we had there Dr. Riley, Professor Cook and a number of the leaders, with a program of considerable extent and as it was the first meeting of this Society that I attended, its proceedings are very clear in my mind.

Now the Association of Economic Entomologists we have, of course, looked upon as a daughter of the Entomological Club of the American Association for the Advancement of Science. We have never before heard that there was anything but a mother of this society, and I have always supposed that this Association of Economic Entomologists

was parthenogenetic, I never heard of any record of the father of the society. I think Dr. Howard speaks for himself as one of the fathers. At any rate, the society was homozygous. It was certainly masculine, and it is one of the growths of the society that it now has a number of women who are doing strong entomological work.

The Club was active for a number of years before and after the organization of this society. With your permission I would like to go back a little from the beginning of this society and mention some of the very early meetings of the Entomological Club, which is the genetic ancestor of this Association. The first meeting of the Entomological Club that I attended was in Minneapolis in the year 1883, and there I met the first group of entomologists that it had ever been my privilege to meet, as a group. I had met Professor Riley some years before, in the year '76, I think, and I got some inspiration from that very remarkable, energetic entomologist. But at Minneapolis, along with Professor Riley, there were present Professor Forbes; then in the early years of a notable career; Professor Saunders of Canada, a very charming man indeed and whom I came to consider a close friend in later years; Professor Kellicott who was then located in Buffalo, before he went to Ohio; Miss Murtfeldt of Missouri; C. S. Minot then interested in insect histology, and there were one or two others. But these were the outstanding figures of that meeting, entomologically. I got inspiration for my work there such as all younger members get in early attendances at these meetings. It is an inspiration and stimulus to meet with the older men and find out something about their methods of work, and their personal characteristic.

Now of the original charter members of this society I would like to call the roll, or mention some of the more conspicuous ones, at least, because I think that some of them are practically unknown, or their work not particularly familiar to the present generation. The work they did was so far in the past, there has been so much other work since, that has claimed attention, that it seems to me the students working now often fail to appreciate the quantity or quality of work that has been done by the pioneers. I was not fortunate enough to ever meet Dr. Fitch, or Harris or Walsh or Thomas, but most of the other economic workers I have had a chance to meet and have had in that way an opportunity to appreciate their work better I think than if I had not had personal acquaintance.

On that original list, Professor Riley of course is recognized as the father, almost, of economic entomology in America. His reports on Missouri insects have stood as a classic, and are even yet a model for economic investigation. Professor Forbes has been mentioned already

as one of the leaders in entomological investigation, and his series of reports is one of the striking features of entomological publication for the country.

Professor Cook was a very enthusiastic, energetic man, and I thin that those who knew him personally appreciated his personal character He stimulated a number of young men to go into entomological work, and you know, of course, the fine work done by some of his students.

Professor Comstock has already been before you and I need not say more than a word of praise for his work. I don't know what we would have done without the books and papers that he has written. Professor Comstock and I have had a long standing disagreement. I don't know that he knows of it. We have never had it as a matter of contest between us, but it shows that disagreements can exist without people being aware of them. I don't need to tell you what it is because it is not a serious matter at all and has never interfered with our friendship or lessened my esteem for him.

To go on with the list here, Professor Harvey was one of this original list. He was a professor in Maine and before that in Arkansas.

Professor Webster was perhaps known to quite a number of you because his work extended up to a few years ago. Probably a number of you met him at the Columbus meeting only five or six years ago.

There are two members, Beckwith and Campbell, that were personally unknown to me of this whole list of charter members.

Professor C. M. Weed was one of the charter members at the original meeting, an entomological writer for the old *Prairie Farmer* and whose work in Illinois and Ohio opened a number of new phases of work.

James Fletcher, of course, was one of the outstanding figures of that group of men. He met with us very frequently, especially after the organization of this society, and was always the life of any group of entomologists that got together. He was one of the most charming men to talk with that I ever met in my life.

Professor Bethune has been mentioned, and I think we can give him a great deal of praise for the splendid work that he did on "*The Canadian Entomologist.*" I keep that Journal on my nearest shelf and look at it with a great deal of interest. I started taking that magazine in 1882 and later secured all the back numbers, so I have the complete set before me as an indication of what can be done in continuity of entomological work.

Mr. Wickson was first entomologist and later became director of the experiment station in California, after which he dropped out of entomological work.

Professor Woodworth was for a long time head of the entomological work in California, and was entomologist of the Arkansas Station in 1889.

Professor Garman is still at work in the Kentucky Station.

Professor Lugger who was for a time entomologist in Minnesota, died a number of years ago.

Professor Gillette is still director of the Station in Colorado.

Professor Bruner, one of that group, has a long record of useful service as entomologist of Nebraska.

Dr. Howard doesn't really need to be mentioned at all. He was one of my earliest entomological friends. I ought not to speak of individuals who are not dead but I do want to speak a little about him. Dr. Howard said to me the other day, "You and I have worked together for forty years and never had a fight." That is quite a record for good fellowship; certainly it is quite a record for Howard. (Laughter)

Now, regarding the character of the work of the Association, I think it was mentioned yesterday that the Association was organized as a research society. I do not entirely agree with that. So I want to give you a little account of the early work of the society to bear out my objection.

The first title was "The Association of Official Economic Entomologists" and that was patterned after, I think, the title for the chemists who called themselves the "Official Agricultural Chemists of the United States of America." We held that name for a short time. The idea I think was that it would include those who were officially in entomological work. I remember that there was some question about my eligibility because I was not a station entomologist. Most of them were. The teachers of entomology were a little bit in doubt, and I was pleased of course when they did come around and decide that a teacher in an agricultural college might be an official entomologist. If you will look at the early records, you will find that there was a distinct question of the eligibility of Professor Packard. He knew as much entomology perhaps as any one, except Professor Comstock or Dr. Hagen who was certainly one of the most learned entomologists of that date—the early eighties—and one whom I was glad to know.

I had the pleasure of working one winter with Dr. Hagen and the main thing that he tried to impress on me was that I should not be an economic entomologist. That particular part of his advice I didn't follow.

Now, coming back to the question of the purpose of the society, I think that it did include definitely the matter of instruction in entomology as well as research. The station entomologists of course were definitely research men, but many of them—in fact, most of them—had also the duty of teaching in the agricultural colleges or institutions

of various kinds. So that the combination of research and instruction was certainly a part of their duty, and really a part of the purpose of the original founders of the society.

Moreover, the men in that work, in most cases, I think, had also to do what we would now call extension work. These men went around to agricultural and horticultural societies and sometimes to farmers' institutes, to talk about insects and methods of control for insects, and they were doing the kind of work we have specialized down to a distinct branch of extension entomology. So that we were trying to do in that time the different phases of economic entomology that have been specialized and developed into particular fields at the present time.

The society stood for these different phases of work, so I think it would be a mistake to say that it was strictly and specially a research organization, although every man in it appreciated research work and attempted to do something with it himself.

I think I have given as much as my time permits for the early history of the society and I do not think I need to take your time any further. Thank you. (Applause)

TOASTMASTER W. E. BRITTON: Gentlemen, if there is any controversy between Dr. Howard and Prof. Osborn I would like to have it settled here and now. I think we can promise them plenty of seconds.

It has already been mentioned that Canada and the United States have lived on friendly terms—especially the entomologists—for more than one hundred years. We came up here with a good deal of interest. When I saw your giant policemen of Toronto, I didn't wonder that our relations have been friendly. In fact, your magnificent specimens of mounted policemen make a wonderful impression. I don't believe that a single member of this Association would be eligible for membership in that organization unless it is Newell, and you will notice that he didn't come. That, I think, explains that we understand each other. As Opal Whiteley would say, we have the understanding heart. (Laughter)

Now I heard the address of the President of your University the other night, a very charming one, and he spoke about your modesty. I think you are too modest, especially in so far as entomology is concerned. Of course we have known of the work of Provancher, Harrington, Saunders, Fletcher and Hewitt, no longer living, and the great work they have done. Those of us who had the pleasure of knowing Dr. Fletcher missed him very much when he was taken away. He was one of those very genial men with a great heart, large enough to take in your whole Dominion, the United States and all of North America—in fact, all of humanity. He was a very human man, and a

very true friend. Of course, Hewitt, following him, organized a large Bureau of Entomology in the Dominion. That is one thing that Dr. Howard has to look out for. There is going to be some rivalry between the Bureau of Entomology in Canada and that in the United States. But probably they will continue to help each other as they always have.

I find that you have a large number of promising young entomologists in the service. I was greatly pleased at hearing a paper from my near namesake the other day, and if he can hustle in his entomological work as he hustled in giving his paper, all the entomologists in the United States will have to look to their laurels. (Laughter)

Now we have one more speaker on the program who can tell us something about the work that the entomologists are doing in Canada at the present time. I am going to introduce as the next speaker, Professor Lawson Caesar, professor of entomology at the Ontario Agricultural College. (Applause)

PROFESSOR LAWSON CAESAR: You spoke about the modesty of Canadian entomologists, Mr. Toastmaster. I don't know whether it is modesty or just what it is, but this evening so far as I could find out, our worthy president must have visited every member of the Entomological Society of Ontario, asking him to say a few words. He finally came to me and said, "Caesar, you have got to do it. Every other man said, 'I am afraid. Those fellows know too much for me.' But Caesar, you don't mind," (Laughter) So that is my excuse for speaking for a few minutes to you to-night.

As I listened to Dr. Howard, Dr. Comstock and Prof. Osborn, a thought came to me which I believe expresses the feelings of my fellow Canadian entomologists. The thought was: that though we have had excellent meetings the last three or four days, tonight's meeting has been in real value the equal of all the others combined. I think that expresses the feeling of all of us. (Applause)

One of the wonders to me is that Dr. Howard, Dr. Comstock and Prof. Osborn are today just as enthusiastic in their subject as they ever were. And any of you who knew Dr. Fletcher knew that he was one of the most wonderful men in his enthusiasm. I believe that many of us Canadian entomologists owe our first interest in entomology to having listened to Dr. Fletcher. I was thinking that if Dr. Fletcher had been here along with these other men with his genial talk to add to what has been said, the meeting would have been almost too excellent.

For Canadians, it is a great treat to have had the opportunity to be at this meeting of all the entomologists of North America. We have looked forward to it with a great deal of pleasure. We cannot, with

the same ease as can some of you, go to the American meetings each year and get the value of what is said there, and meet the men there that we should like to meet. So this meeting has been a very great treat indeed to us, not only in the way of the information gained, but also in the social intercourse that we have had with each other.

I cannot sit down without making a few remarks that I know any man who might be taking my place here tonight would like to make. That is in regard to the debt of gratitude that we owe to our entomological friends across the line. It seems to me that we should have been utterly lost during the last twenty years had we not been able to go to them for the assistance that we needed. We have been few in number until the last few years. Why, even at Ottawa there were only about five entomologists when Dr. Hewitt came there. But now I believe there are about fifty on the Ottawa branch. Until the last few years we have had to send our specimens across the line to have them identified, and I sometimes wonder at the patience that Dr. Howard shows in taking the trouble to name those insects for us and to give us the information on them that we desire.

So we owe a great debt to the Washington Bureau, not only to Dr. Howard himself but also to many of his assistants who have helped in connection with these things.

The debt that we owe to Dr. Comstock I cannot put into language. There is not a man—at any rate in Canada—who has not been brought up on Comstock's manual. (Applause) One of the things we are looking forward to today is the New Manual which Dr. Comstock is preparing. We don't want him to hurry with it but to take his own time; and we know that what the book will contain will be just as nearly right as it is possible to make it.

Now, we should like very much to have as many of the entomologists of the United States as can find opportunity to do so, attend from year to year the meetings of the Entomological Society of Ontario. It is not a provincial society at all. It is in name, but in reality it is a Dominion society. We do not want you to come just to please us, but we want you to come to enjoy our meetings and to discuss things with us, just as we want to go back to your meetings and to get pleasure and benefit from them.

I often think that now that we are beginning in Canada to devote a great deal more attention to entomology than we did in the past, that we will be of some help to our frineds across the line, in that we shall be able to give you data from different climatic conditions to what you have over there; and so by cooperating together in the study of insects, both countries are going to gain much more than either country would alone.

Before sitting down I should like to say that a good many of you have never visited Guelph, and we should be glad to have any entomologist who finds it convenient, on his way home, call at the Agricultural College and look over the institution, and come into the entomological department and see anything we have to show you. It is only about forty-five miles. There are several trains a day going there and you can slip up to the college in a few minutes by car when you reach Guelph. I may not be there myself but Professor Baker will show you around.

In conclusion I should like to say that this is the Christmas season and on behalf of the Canadian Entomologists I wish you all a happy new year. (Applause)

The members called for some remarks from Mr. Arthur Gibson.

Mr. Arthur Gibson: I didn't come here tonight prepared to speak. I thought I had "passed the buck" very rightfully to Prof. Caesar, our provincial entomologist, and in whose province our meetings are being held. I am glad, however, to add a word or two to what he has said.

As I mentioned at the meetings today and yesterday, the entomologists of Canada have welcomed very much our visitors from across the line. Instead of having you accept the invitation of Prof. Caesar to visit Guelph, I would like to have you all take a train from Toronto at night, before you leave for your homes, and arrive in Ottawa the next morning. We could give you just as good a time as he could at Guelph. And then too we could take you across to the beautiful city of Hull where prohibition is not yet wholly in effect!

I would also like to second Prof. Caesar's remarks and express to you all again our sincere pleasure in having you with us at this conference. May I also repeat what he said, and wish you all a very happy new year.

Toastmaster W. E. Britton: It seems to me that one of the very best things about this meeting is that we have been getting acquainted. I suppose some of our men from the States will have to return, but now they have learned the way I am sure that some day they will visit both Guelph, and Ottawa, and will also probably stop on the way at Hull.

I would like to propose a toast to the relations between Canada and the United States. May these Nations always stand shoulder to shoulder, heart to heart, and hand to hand, comrades in war, in peace and in entomology. Will you please rise?

The members drank a toast to the relations between the United States and Canada.

TOASTMASTER W. E. BRITTON: This closes the program for the evening, and I wish to thank you for bearing with me so patiently. We will now turn the meeting over to the President, who has an announcement to make. (Applause)

PRESIDENT GEORGE A. DEAN: As I have sat here this evening and listened to the admirable and charming addresses of the pioneers or charter members of this Association, an Association which has done so much to promote a well-balanced growth and development of the science of economic entomology, I have been deeply impressed by the splendid spirit of sacrifice which has dominated their lives and led them to devote their lives to the accomplishment of so much constructive work.

As has been stated this evening, a few energetic workers met in this city of Toronto, thirty-two years ago last August, and organized the American Association of Economic Entomologists. The wonderful success of the organization and its long record of usefulness has certainly justified the venture which was launched by these men who had that rare faculty of seeing the possibilities and opportunities of the future.

During its rapid and healthy growth from not more than a dozen members to a membership at the present of nearly 700, the Association has had 31 presidents, two of whom, Dr. Riley and Dr. Forbes, have served two terms. Of the 31 presidents, 8 are gone, but the memories and the classical contributions to science by such men as Riley, Fletcher, Lintner, Webster, Slingerland, Smith, Fernald and Hewitt will remain as long as the science of entomology endures.

Of the 23 past presidents who are living, more than half of them are present this evening.

Two years ago when the Committee on Resolutions, consisting of Messrs. Sanders, Ruggles, and myself, recommended to the Association the presentation to the past presidents of an engraved diploma, little did we realize what a fitting occasion would occur as this, the thirty-second anniversary, in the city of Toronto, where this Association was not only organized but also at which place the first annual meeting was held.

As President of the American Association of Economic Entomologists, it is my privilege and indeed a great pleasure to present to each of you in order of your term of presidency these diplomas. The diplomas are presented by the Association in appreciation of the honor each of you have so well earned by your fine spirit of sacrifice and your splendid endeavor to the development of the science of economic entomology.

It is particularly appropriate that the first diploma should be presented to Dr. Howard, who not only served on the original committee of organization, but who in order of term is also the oldest past president.

PART II, ADDRESSES, PAPERS, AND DISCUSSIONS

Morning Session, Thursday, December 29, 1921

At the close of the business session, Vice-President Arthur Gibson took the chair.

VICE-PRESIDENT ARTHUR GIBSON: One of the most important items on the program each year is the address of the President, and it is my pleasure to introduce President Dean, who will address you on the subject of "How We May Increase the Effectiveness of Economic Entomology."

HOW WE MAY INCREASE THE EFFECTIVENSS OF ECONOMIC ENTOMOLOGY

By GEO. A. DEAN

Entomologist, Kansas State Agricultural College and Experiment Station

With the publications of Walsh (1865–1869) and the early publications of Riley (1868–1877), Economic Entomology in the United States began to advance rapidly. The classic contributions of these two men, particularly those of Riley, laid the foundation for the economic entomology of the world, and the rapid growth that followed soon placed America at the head of all countries, a position she has continued to hold. Economic Entomology has contributed much to the marvelous development of American agriculture, which forms the basis of American civilization and prosperity. With this rapid development, not only have many new fields for research been opened and great opportunities for service offered, but the problems also have become much more complicated and the entomologist's relation to them much more intricate.

If the great problems are to be solved and the entomologist's splendid position of service maintained, three fundamental considerations must be recognized. (1st) Fundamental training for research must be insisted upon and its importance emphasized. (2d) An agreement as to which are the most fundamental problems of research and which are the most promising methods of attack must be reached, so that the

available resources may be concentrated. (3d) A workable plan for cooperation among entomologists, with other scientists, with public and private agencies and with the general public must be developed and supported.

Education and Training

The matter of education and training is one to which considerable attention may well be given. Economic entomology is a science intimately related not only to all other biological sciences, but also to many of the other sciences. Since it reaches out in its great variety of adaptations and touches almost every vocation of life, it would seem that any person who has given the subject earnest thought would advocate a broad and fundamental training along all biological lines for the person who would enter the field of economic entomology. Never in the history of education have our educational institutions and research laboratories offered better opportunities than they now offer for the student to receive this broad and fundamental training. In many of these institutions there are teachers of excellent training, broad vision and high ideals. Every year there are entering the field some splendid young men, well trained in science, and full of enthusiasm and zeal, who have caught the proper inspiration and have the right attitude in research. But is this any reason why our educational system should not be studied to ascertain if the basic studies are being offered? However, it is not my purpose to discuss this important problem, because growing out of Dr. Ball's admirable address given at the thirty-first annual meeting, there is the Committee on Policy, under which there is a committee on education, whose problem it is to study our educational system to discover whether the basic and fundamental subjects in the training of students are being offered and required. I look forward to a report from this committee that will be of vital importance.

Research

Out of the lessons and experiences of the recent war came an unprecedented recognition of the value of research. Never before have the nations, particularly our own, been so willing to give encouragement and support to research. Never before have there been so many well trained men engaged in research, and so many great economic problems. On the other hand, is there not a large amount of lost motion? Is there not a lack of organization, cooperation and coordination? Are not a large number engaged on research problems of minor importance, and many working on problems and getting nowhere, and

are there not some great basic problems practically untouched? As illustrations, one might mention the reciprocal relations of soils and insects, the influence of temperature and moisture on insect life, the breeding of insect-resistant varieties of plants, and the relation of insects to the dissemination of plant diseases. Would it not be a good plan for this Association to make a thorough study of our multiplicity of research problems and endeavor to decide what are the most essential, and then plan for concerted attack on the large problems, especially those that require numerous cooperative workers? But, it is not my purpose to discuss the research problem, as basic as it may be, for here again the subcommittee on research of the Committee on Policy is studying this phase of our entomological work, and I hope we may soon have from them a report on this important problem.

Cooperation

Although the importance of fundamental training and research cannot be over-emphasized, and while I would not in any way minimize these two problems, there is, in my opinion, a larger problem, namely cooperation, or the development of a workable plan for coordinating and harmonizing all activities not only in entomology but also in related fields. In the final analysis is not the ultimate purpose of all research to serve the public, and can this ever be fully accomplished unless the closest cooperation and sympathy exist? I am well aware that in recent years so much has been said about cooperation and there have been so many failures that the word "cooperation," like the word "brotherhood," has become repulsive to some. Yet, by placing constant emphasis on the problem, may we not expect our efforts to lead to constructive activities? True, there will always be in each group some individuals who are intensely selfish and who seek every advantage for themselves without regard to the interest of the public, but the hopeful sign at the present is the realization that those who take the larger view are increasing steadily, and the spirit of cooperation is growing.

One of the essential requirements for the largest success of a research worker is that he be imbued with a spirit of altruism. If there is any class of scientific men that should appreciate the value of cooperation and recognize the wonderful opportunities offered for cooperation, and be able to profit from the failures due to the lack of cooperation, it is the economic entomologist. He is engaged in a work that not only reaches out in its great variety of activities, and touches almost every vocation and activity of life, but which also has many striking examples of work accomplished through cooperative activities, as

well as some glaring examples of failure, due to selfishness and lack of cooperation, and opportunities lost, due to the lack of vision and lack of aggressiveness.

Cooperation Among Entomologists

Throughout the country there are a large number of economic entomologists working on very similar problems, and to a considerable extent independently of each other. Of course, these investigators can learn more or less of what is going on by attending meetings, reading current publications, and corresponding with fellow workers. But in this there is comparatively little cooperation between the numerous agencies and no direction or supervision which would result in concentrating efforts along the most desirable lines, enabling the workers not only to do more efficient work and to render more effective service, but also in many instances to avoid unnecessary duplication.

It would seem that one of the best means of promoting close cooperation would be for those workers who are interested and engaged in similar entomological problems to hold conferences and field meetings. Conferences of this sort are certain to stimulate interest in economic entomology and focus attention on economic problems of outstanding importance. Conferences between entomologists for the purpose of exchanging ideas, holding advantageous consultations and observing experimental results of special significance are highly desirable and are almost certain to result in speeding up research and experimental activities. Perhaps one or two examples, with the details of which the writer is well acquainted, will illustrate.

Fourteen years ago the departments of entomology and agronomy of the Kansas Agricultural Experiment Station began an extensive series of experiments on the preparation of the seed bed and the time of planting wheat not only for maximum yields but also to escape injury from the Hessian fly. In order to secure the data bearing on the problem, a series of experimental sowings was begun which was to extend over a period of ten years.

The experimental sowings were carried out at a double series of stations, one along the eastern and one along the western edge of the great central wheat belt of Kansas. Each sowing consisted of seeding a series of plots at weekly intervals for six or seven weeks, beginning the second week in September. The stations were always secured and managed cooperatively by the departments of agronomy and entomology. Representatives of the United States Bureau of Entomology visited most of the stations each year, taking such data as they desired. As a result of the long series of experiments, Kansas not only has a method of Hessian fly control that is practically 100 percent

effective, but also valuable data for every part of the state regarding the preparation of the seed bed and the time of planting for maximum yield. There are no conflicting statements emanating from the experiment station. The agronomist, the entomologist, the director of the experiment station, the county agent, and the wheat grower, all talk the same language. In addition to this, the Kansas Station has very valuable data on the life history of the Hessian fly, the number of broods, its behavior, its migration, its dispersion by winds, and its susceptibility to moisture and temperature. The point, however, that I wish to make is that if a similar series of experiments had been conducted in all the winter wheat states, subject to injury from the Hessian fly, who would dare to estimate the amount of valuable data we would have on this important insect?

If at the beginning, a regional meeting could have been held between the entomologists and the agronomists of the interested states, and the plan of the experiments explained, ideas exchanged, and later experimental results observed, it is probable that similar experiments would have been inaugurated, and to-day we would be reaping the results of unification of efforts, and the great wheat growing industry would feel the force of our work as a solid impact.

It is estimated by the Federal Bureau of Entomology* that in the year 1907 there was a loss of not less than 50,000,000 bushels of oats and wheat in Kansas, Oklahoma, and Texas, due to the green bug. Seventy percent of the wheat acreage in Texas was abandoned that year because of the ravages of this formidable pest. Other outbreaks, though much smaller, occurred in 1911, 1919, and 1921. During the first outbreak, although there was some splendid cooperation between the Federal Bureau and the Kansas Station, there was but little cooperation between the entomologists of these interested states or between the different departments in a single state. Articles soon appeared in the farm journals and newspapers diametrically opposed to each other. The entomologist of one state with more than a full page article in the leading farm journal of that state was bitter in his attack on the state entomologist of another state. Publications even appeared in bulletin form discrediting the work of a fellow worker. While this envy, jealousy and bitterness was on display, the green bug was playing havoc with the wheat and oats, and the farmers were disgusted, not so much with the green bug as with the silliness and foolishness of the entomologists. Since the 1907 outbreak of the green bug, three smaller outbreaks have occurred, each furnishing splendid opportunities for an extensive study, but each time very little

*Farmers Bul. 1217, U. S. Dept. Agric. 1921.

was accomplished, due to the lack of any well-thought-out plans between the entomologists of the interested states and the Federal Bureau. As the result of this more or less of a hit and miss proposition, we have scarcely arrived anywhere with the most fundamental aspects of the green bug problem. At the present time there is a difference of opinion between the federal entomologists and those of Kansas as to the origin of these outbreaks. The federal entomologists and the entomologists of Kansas do not agree with the pubished statement of the state entomolgist of another state as to the origin of the small outbreak last spring in southeast Kansas. The green bug problem is one that cannot be worked out in a single state, and the entomologists will never get at the bottom of the situation until they decide to get together on a whole-hearted, well-developed, cooperative plan. When this is done and the origin of the outbreaks are definitely known, they can then expect to render effective service along the line of efficient control.

Many examples could be given by a large number of entomologists of the efficient work and effective service rendered by cooperative experiments. Several have attended regional conferences and field meetings, and know that they are highly desirable. They know that out of these conferences constructive activities have grown, whereas if it had been left to the initiative of the individual, no important result would have been accomplished.

I firmly believe that one's greatest inheritance is individual initiative, and in all this work I do not favor any step that would discourage the initiative of the investigator nor do I favor any plan that would lead to the establishment of anything that savored of autocratic control. But it does seem to me that entomologists must learn to work with others and that there can be a closer cooperation between state and federal entomologists without jeopardizing in the least the freedom or the reputation of either. Along this line I am particularly grateful for the recent organization of the Crop Protection Institute and believe that the Association of Economic Entomology, by endorsing the Crop Protection Institute and placing itself on record in favor of this organization, took a big forward step, just as it did when it formally approved of and promised its support to the National Research Council.

Cooperation Between Entomologists and Other Scientists

While the economic entomologist recognizes the fact that his science is tremendously broad and intricate, and in its many aspects is intimately related to all the biological sciences, he has, nevertheless, given very little attention to the relationships with other scientific workers, and has proceeded with his insect problem as if it were one for the exclusive attention of an entomologist.

It must be made clear to every student in economic entomology that our studies in the sciences have been too restricted and that there is such an interrelation and interdependence of our problems with those of other fields that the development and solution of them cannot be considered separately without loss.

The entomologist of the future will be required more than ever before to deal with problems involving interrelationships between many fields of science. Unless he has a comprehensive knowledge of chemistry, physics, plant pathology, plant genetics, agronomy, horticulture, geology, bacteriology, sanitation, and other subjects likely to enter into his problem, he cannot expect to get basic results which will contribute to the development of a nation. It is not meant that the entomologist must be a specialist in all the biological sciences. This is impossible. But it is meant that if an entomologist is to develop successfully a problem and overcome its difficulties, he must be equipped with sufficient fundamental training in the different lines to be able to recognize the obstacles encountered, and interpret the factors involved in his experiment. And when he has done this, he should be big, broad and generous enough to invite to his assistance the scientists who can materially contribute to the solution of his problem. In fact, his training should be such that, in planning and developing his problem he will be able to foresee the different interrelationships and the possible and probable difficulties, and sense the desirability of calling into consultation, and even active participation, investigators in other lines. The effective method of Hessian fly control in Kansas is not the product of an entomologist, but the product of a long series of cooperative experiments of entomologists and agronomists.

Kanred wheat, a hard winter variety that is outyielding any other hard wheat by several bushels per acre, that is rust-resistant, that stands at the top in milling and baking qualities, is not the product of a single individual, but is the product of the Kansas Agricultural Experiment Station. It was bred and selected by a plant geneticist. Its yielding qualities were determined by agronomists in cooperative work with farmers; its rust-resistant characters were ascertained by a plant pathologist, and its milling and baking qualities were the work of flour milling engineers, baking experts and flour chemists.

If any Experiment Station produces a wheat that is Hessian fly resistant and has the other necessary important characters, it will not be the work of an entomologist alone, but will be the result of a cooperative project between entomologists, plant geneticists, plant physiologists, plant pathologists, and agronomists.

Cooperation With Industrial Concerns and Other Private Agencies

Many illustrations could be given of splendid results accomplished by entomologists' cooperating with industrial concerns and other private agencies. As one studies this problem, he is increasingly impressed with the many possibilities offered, and the numerous fields practically untouched. Along these lines, Parrott, a foremost student of this kind of cooperation, and our representative on the National Research Council, in his report a year ago to this Association, says "There also exists a large opportunity for enlisting the support of men of affairs, who can assist in coordinating civilian enterprises with entomological activities and shaping public sentiment in its judgment of the character and efficiency of entomological efforts in behalf of national welfare. Industrial concerns, individually and collectively, are prepared to grant funds for the investigation of special practical problems."

In the Crop Protection Institute affiliated with the National Research Council and endorsed by this Association, there is a splendid organization for doing cooperative work with industrial concerns and with their cooperation and their support to accomplish some really stupendous tasks.

Cooperation With The Public in Insect Control

This represents one of the most important phases of economic entomological work, since in the last analysis the ultimate purpose of our studies and research is to discover and develop practical methods of insect control and to serve the public, not only by devising machinery for the practical operation of these methods, but also in assisting in the running of this machinery. The Crop Protection Institute affords a much needed organization for cooperative work on general problems of insect control. If it receives the proper support, it should be able to establish a unity of interest and demonstrate the possibilities and value of regional cooperative insect control.

Undoubtedly the greatest and most important organization for concerted action in insect control is the state and county farm bureau. It is difficult for the writer to understand why some of our station and state entomologists are not using this splendid piece of machinery. That the county farm bureaus within a state can be organized into an efficient machine which can be thrown into action and present a solid front within a period of two or three days is no theory. It is this organization that makes it possible for the farmers of Kansas effectively to control the Hessian fly infestations and the grasshopper and army worm outbreaks.

In cooperative insect control, the extension entomologist is a most valuable man. In fact, I believe that economic entomology, research and extension entomology are inseparable from and indispensible to each other in a real department of entomology that intends to serve the public. The extension entomologist who represents such an important phase of entomological work should be closely affiliated with the department of entomology. His plans and his work should be worked out in close cooperation with and be approved by the head of the department, or some person in the department who is in direct charge of that particular work. Otherwise friction is almost certain to result, and information will get abroad that will be no credit to entomological work or to any institution. The extension entomologist should have his office in the department of entomology, where he may keep in close touch with the work not only in the department, but in the whole station, and where he will feel that he is one of the men of the department. Furthermore, the extension entomologist should be permitted to carry on some independent research work in the department.

In cooperating with the public, advantage should be taken of the valuable help which can be rendered by organizations such as the grange, farmers' union, bankers' associations, grain associations, millers' associations, fruit growers' associations, railway companies, canning associations, various clubs, etc. In much of the work of this sort, while the entomologist should be the leader in the organization, and the underlying force in the operation of the methods of control, he should know how to step into the background and let the county agents, or the particular organizations through which the work is done, feel that they are important factors and function as such.

Conclusion

If economic entomology is to fulfill its destiny and keep abreast with the rapid growth of other biological sciences and the marvelous development of agriculture; if it is to continue to make notable contributions to the progress of the nation and the world; if it is to develop on that broad and constructive plane so necessary for the rendering of the maximum service and usefulness; if it is to accomplish achievements of such importance as to be the subject of favorable comment and receive the commendation of the general public, there must be a closer cooperation and a more sympathetic and generous attitude: 1st, between state and federal entomologists; 2d, among state entomologists engaged in similar entomological problems; 3d, between entomologists and the other biological scientists; 4th, between entomologists and medical men; 5th, between entomologists and industrial

enterprises; 6th, between entomologists and sanitation engineers; and 7th, between all of these and the general public. In the undertaking of such a plan, there are involved so many fundamental principles to which such careful consideration must be given that the task assumes enormous proportions. If there is developed a workable plan that will insure efficiency, it will not be the product of a single person, but of a group of men who have that rare faculty of seeing the possibilities and opportunities of the future and who believe the impossible can be done. Because the task is stupendous; because there have been failure and quarrels in the past, due principally to misunderstanding, petty jealousy and lack of vision; because there are those who cry out "that it can't be done," should one fold his arms in hopeless despair and cry out "impossible?"

Is there any reason to despair of ultimate success when there is so splendid an organization as the National Research Council with which so many associations, scientific societies, and industrial concerns are affiliated, already clearing the way? No, I believe not, for never before have the entomologists had better opportunities for fundamental training in research. Never before have we had such a large group of well-trained men filled with inspiration, interest and zeal. Never before have we had more promising opportunities to render real service; nor has there been a time when such splendid machinery for service was waiting to be thrown into motion, and never before have we had such an opportunity to organize the intellectual forces of our Association into a movement that will have a profound influence upon the future of our science and the well-being of our country.

VICE-PRESIDENT ARTHUR GIBSON: The discussion of this address will take place at the beginning of the afternoon session.

President Dean resumes the chair.

PRESIDENT GEORGE A. DEAN: The next subject is

ECONOMIC ENTOMOLOGY IN QUEBEC DURING THE LAST DECADE

By REVEREND FATHER LEOPOLD, *Agricultural Institute of Oka, La Trappe, P. Q.*

(Withdrawn for publication in the 52d Report of the Entomological Society of Ontario for 1921)

Adjournment.

Afternoon Session, Thursday, December 29, 1921

The session was called to order at 1.30 P. M. by Vice-President Arthur Gibson, and the first paper was presented by Mr. E. G. Kelly.

COOPERATION OF AGRICULTURAL COLLEGES WITH HIGH SCHOOLS AND RURAL SCHOOLS IN ECONOMIC ENTOMOLOGY

By E. G. KELLY. *Extension Entomologist, Kansas State Agricultural College*

In teaching entomology to students of agriculture in high schools and rural schools to-day, we are training leaders for "Insect Control Teams" in the insect out-breaks of tomorrow. With this slogan in mind, the writer began working with high school students in 1915, even before he took up work with the Kansas Agricultural College. Mr. E. A. White was elected teacher of agriculture in the Sumner County High School of Wellington, Kansas for the term of 1915–16. I was appointed chairman of the committee on agricultural projects by the board of trustees and directed by them to outline the agricultural project work for the high school. Among the other projects undertaken by the agricultural class was insect control. During the fall of 1920 and again in 1921, Mr. W. A. Boys, County Agent of Sumner County, used some of the boys who received entomological training in 1915–16 in organizing his chinch bug burning campaign. He found that these men had been so well drilled that further explanation was unnecessary, thus making his work much more efficient than where untrained men were used.

In 1918, shortly after assuming my present duties as extension entomologist of the Kansas State Agricultural College, I was working on grasshopper control in western Kansas, a report of which was presented to the America Association of Economic Entomology at the St. Louis meeting. In this report no mention was made of the work done through the rural high schools. In Pawnee County, Mr. R. P. Schnake and the writer worked in three schools during the spring term, teaching the agricultural classes how to mix and distribute poison bran mash. In the immediate vicinity of these three schools the grasshoppers were controlled during the outbreak in the fall of 1918, and these boys were used as instructors by the county agent in the campaign against the grasshoppers in 1919. These two instances are sufficient to show the possibilities of cooperation between the college, the high schools and the rural schools.

In the early spring of 1920, this cooperation was continued by organizing orchard management teams in classes in vocational agriculture, at Ashland, Bucyrus, Effingham, Bonner Springs, Oskaloosa and Lawrence. These teams were trained in pruning and spraying; the

training in spraying being given with special reference to the control of insects. These teams were also taught to recognize many of the orchard insects. After receiving this training under supervision of the entomologist these boys had an opportunity to put theory into practice by pruning and spraying the home orchards for many of their neighbors. These orchard management projects were continued, and the schools at Seaman rural (Topeka) and Marysville were added in 1921.

By special request from a number of the vocational agricultural teachers to their director, Prof. C. V. Williams, I was invited to appear before the conference of vocational agricultural teachers, held in Manhattan the first week of June 1921, to discuss the plan for cooperation and organization of orchard management teams. This invitation was accepted and advantage was also taken of the opportunity to present a plan of cooperation by which entomology might be taught to vocational agriculture classes. The plan, which met the approval of the vocational agriculture teachers and their director is as follows:

1. That the vocational agriculture teacher have a well organized class in agriculture consisting of not less than ten boys.

2. That the vocational teacher pledge himself to take the correspondence course in economic entomology as given by the Home Study Department of the Kansas State Agricultural College.

3. That each teacher receiving these lessons, shall teach his agriculture class entomology, not less than one hour per week, using these lessons as a basis for such instruction.

With this plan in view, Mr. George Gemmell, of the Home Study Department, and I arranged 32 lessons on Economic Entomology. This provides for one lesson each week during the school year, allowing for vacations. One lesson is sent to the teacher each week, a special effort being made to have the lesson arrive when the insect can be found in the field.

At the time of the organization of this enterprise, Prof. Williams had 75 high schools in Kansas organized for vocational agriculture, in connection with the Smith Hughes plan, each scheduled to take up this work. However, Prof. Williams resigned the Vocational Agriculture Directorship in July and it became necessary to change the plans, under the new organization. Thus it was deemed advisable to retain only those schools on the entomological project which had their classes well organized, and were in a position to forward the movement without the direction of Prof. Williams. Accordingly, a letter was drafted and sent to each vocational teacher, requesting a statement of progress made in organization of the classes for the work, and asking each to

express his desire to continue or discontinue the work under the new arrangement. From the number responding, there were selected nineteen schools.

Shortly after the beginning of the school year, arrangements were made for the entomologist to spend one day with each of these nineteen schools. The program for the day consisted of a short talk on the lessons which had been received, a short laboratory exercise, and a trip to the farms nearby where insects were studied as they occur in nature. One or two demonstrations of insect control, such as fumigating a wheat bin for weevil, and burning the bunch grass for the chinch bugs were given. One very interesting feature of the field trip was teaching the boys and their parents how to find Hessian fly. On these field trips we usually collected various insects, some which were of economic importance.

The vocational teachers cooperating with the county agent invited the parents of the boys to join us on the field trips. Some of these field trips were very well organized and planned. For example, at Beloit, Mr. S. D. Capper, vocational teacher, has a class of fifteen boys. At the beginning of the school term, Mr. Capper invited the parents of his boys to meet with him in the school room for the purpose of organizing an advisory council.

On receiving word that I would spend a day with him, Mr. Capper called a meeting of his advisory council and they planned the program of the day. It consisted of an hour given to discussing insects followed by farm visits where we studied various insects. The parents of the boys, and neighboring farmers had been invited to attend these meetings and on our arrival at the first farm, we were greeted by an even dozen of them who had come to see the demonstration. We went into a sudan grass field where chinch bugs had recently been very numerous, having damaged the grass to a considerable extent. The farmer had not plowed the sudan grass, but had left it for this occasion. To his great surprise and chagrin, we could not find bugs in the sudan grass. He then essayed to take us to another place where he knew the bugs were plentiful; this time to a corn field, where the corn had been cut and shocked. Here, again, he was disappointed, for all that he could show us were great piles of molted skins of chinch bugs. At this time I discussed the chinch bug and its habits, paying especial attention to hibernation, after which we tramped across the field to the roadside where the blue-stem grass was growing in great clumps. Here is where we found the missing bugs. We set fire to a small strip of the bunch grass, thus demonstrating the most effective method of control for this pest.

We then drove to the second farm selected by the council where we studied weevil in wheat, the farmers accompanying us. The various species of weevil found in the wheat were discussed, and others not present were mentioned. The bin was then measured to determine the number of bushels it contained, examined for cracks, etc., and the temperature of the wheat taken; finally the amount of carbon bisulphide needed was determined. Gunny sacks were placed on the top of the wheat in readiness to receive the carbon bisulphide, the pouring of one pound on each sack was a simple operation; the wheat was fumigated.

The next stop was for luncheon where we were joined by other farmers and the teachers and pupils of three rural schools. Shortly after apples had been passed, advantage was taken of the opportunity to tell them how the worms were kept out of the apples, and by using simple language the codling moth and several other insects were described; their undivided attention was given me for forty minutes.

We were ready to go to our next place when one farmer said he had come to learn about the chinch bug. I requested some of Mr. Capper's boys to explain the subject—they did it well. Another farmer wanted to know about the wheat weevil. The boys told him in a clean-cut decisive manner just how to fumigate the bin.

At every school visited similar interest was exhibited. The boys and their parents took advantage of every opportunity to gain all the information possible about insects. In the nineteen schools cooperating, there are about 409 boys and 42 normal training girls. Many of these boys are deeply interested in insects and each of them has written an essay on one of six entomological subjects submitted to them. These essays were written under the supervision of the vocational teacher and English teacher of the school. In all the agricultural projects assigned to the boys during this school year, insect control will be included as part of the project.

The county agents in the counties where these schools were located, cooperated with the vocational agriculture teachers in making these meetings a success. The County Agricultural Agent is the recognized local leader in all extension activities in the county. He is the man in the county who disseminates information brought to him by the specialist concerning results obtained by the experiment station and United States Department of Agriculture.

In order to work most effectively, he must have a system of local organizations. Among these are the agriculture classes in the high schools and rural schools. In developing the agricultural program for any local organization, whether it is crops, horticulture or live stock, insect control is always included as a part of the program.

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There are fourteen counties in Kansas in which the county agents have organized extension schools, for studying entomolgy. As now planned, the extension entomologist will spend one half day at each of these schools, which will consist of the members of the agriculture class of the local school and the parents of these pupils. Demonstrations on why, where, when and how to spray will be given; also short illustrated lectures on a few of the economic pests. At this time, it is planned to assign to the members of the agriculture classes and farmers some definite entomological work, that they may do, either as teams or as individuals, such as keeping the bugs off their potatoes and spraying fruit trees for the control of codling moth and curculio; the control of chinch bug and Hessian fly and other local insect problems.

VICE-PRESIDENT ARTHUR GIBSON: This morning we listened with a great deal of pleasure to the address of our President. It is now open for discussion.

MR. W. R. WALTON: I have listened with the keenest of enjoyment to Professor Dean's discussion regarding the best means of increasing the effectiveness of economic entomology. I think we can all agree in endorsing his ideas regarding the cooperative relations which should obtain between the State entomological organizations and those of the Federal Bureau of Entomology. In this regard I can and do point with pride to the fact that ever since the Branch of Cereal and Forest Insect Investigations has been under my direction, our watchword in this work has been "Cooperation and Service," in so far as relations with the States were concerned; and I believe that Professor Dean will be the first to acknowledge that such has been the case in his own state of Kansas. I feel, however, that perhaps he does not realize fully the spirit of intimate cooperation in the Hessian fly and other regional problems which has prevailed for years between the Federal organization and those of such States as Ohio, Indiana, Illinois, Missouri, and to a somewhat lesser extent, Michigan. It seems probable also that similar relations maintained with North Dakota, Montana, Wyoming, Arizona, North Carolina, Texas, Virginia, other states and the Dominion of Canada, between the Federal Cereal and Forage Insect men on one hand and the state organizations on the other, have not come to his attention.

Great praise certainly is due Professor Dean and his admirable and enthusiastic corps of workers, together with the Kansas state staff in general, for their invaluable and pioneer work on the control of the Hessian fly and other insects, but I hope he appreciates the fact that similar good work is now being accomplished in other states, in fact, has progressed for years, in full cooperation with the Federal entomolog-

ical agencies. The collaboration of our investigators during the past year with the plant pathologists and agronomists in the "take-all" disease investigations in relation to Hessian fly injury, is a case in point. Referring to the "greenbug" situation, mentioned by Professor Dean, it is true that honest differences of opinion exist as to the true origin of the great outbreaks; but such differences do not necessarily constitute obstacles to progress, indeed they are often the very life of scientific research. The Bureau recently has taken steps (by placing an observer in northern Texas) to settle this matter, once for all, if this should prove to be humanly possible.

I congratulate Professor Dean upon his extremely able and interesting presentation of this most important subject.

Mr. E. P. Felt: It seems to me that Professor Dean in his discussion has struck a keynote which we can all take to heart. That is, a better and closer cooperation, and even in cases where there is an honest difference of opinion, sometimes by consultation, at least a form of statement can be agreed upon which will not result in presenting apparently diametrically opposite views. I feel the liberty of disagreeing with my associates at times, and I expect they are going to disagree with me, but I like, if possible, to keep that out of public print. We ought to present, so far as possible, a united front in urging remedial or control work along any line whatsoever.

There is one thing I would like to mention in connection with Professor Dean's address, and it is also cooperation. I refer to the cooperation that the men in the States should render the Insect Pest Survey work begun last year. That was started, as you gentlemen may remember, partly at least through action taken by this association. There has been some excellent cooperation. There is an opportunity for a great deal more, and it seems to me that this venture—we can hardly call it less than that—is in the experimental stage. It is sonething which should demonstrate its utility. To my mind it has considerable, if not great possibilities. We ought not to be content until those possibilities have been developed to every reasonable degree. We do not think it is going to solve all questions; it cannot. But we ought to have eventually an Insect Pest Survey which will picture accurately and promptly entomological conditions throughout the entire country, so that those cooperating both in Washington and throughout the country would have a better and fuller knowledge of what is going on in insect life, and therefore be in a position to render better service to their clientage.

Mr. S. J. Hunter: I want to express my hearty appreciation of the matter presented this morning by Professor Dean, but more especially to testify that he not only preaches, but he practices what he preaches.

We at the University have enjoyed his cooperation both in the research work and in the teaching work. Professor Dean himself has come to the University and given an entire term of lectures through one summer session, and his men at different times have been with us. He has demonstrated in a very clear manner in Kansas the policy which he has outlined so clearly and cogently and forcefully this morning.

I also want to second what has been said regarding the Insect Pest Survey. After the Insect Pest Survey Bulletin came to us for three or four months, our instructor in economic entomology in the University began using it as a collateral text. It was not suggested to him but he asked the privilege of taking an additional set for that purpose, and I took occasion at that time to write Dr. Howard expressing our appreciation of the information contained.

I have a feeling that the President's address stimulated what is already growing in the atmosphere. I wish to congratulate him on the thoughtful and comprehensive way he has presented the subject of cooperation to us.

Mr. W. C. O'Kane: You will remember that in dividing the various portions of his address, Professor Dean spoke first of research, as indeed he should since it is fundamental in any science. Then he went on, however, and showed the importance of various other aspects of economic entomology besides research; the relation, in other words, of the economic entomologist to his public, to his fellow workers in other sciences, to the industries with which he comes in contact, and so on.

Now economic entomology is one of the two sciences in agriculture that is of a corrective or remedial nature, the other one being plant pathology. It is in daily comparison in the State Department at Washington or in the State Experiment Stations with such constructive sciences as agronomy, horticulture and so on. We are like the doctor who is called in at the last minute and as a last resort and quite unwillingly, and who is discharged the sooner the better. In other words, our science is one which is of a corrective, remedial, preventive nature.

Therefore, like any other such science, it has strong engineering aspects. I personally believe those engineering aspects are of very rapidly increasing importance at the present time in economic entomology. One thing I liked especially about Professor Dean's admirable address is the fact that he made clear what those aspects are.

Mr. H. A. Gossard: I rather wondered this morning, when Professor Dean was reading his paper, if he had been up in our section of the country in the last two or three years and studying what we are doing. We were apparently doing, over in that quarter of the world, about all the things that he was recommending, and I believe we are actually getting somewhere. We have enjoyed very efficient cooperation

with the Federal Bureau of Entomology, we have had meetings or conferences of entomologists in that section of the States, one or two each year, and worked out our common problems together. We have all of the entomological agencies—the research agencies and the teaching forces—and we are utilizing them all. The Farm Bureaus also have helped us out wonderfully.

I certainly endorse practically everything that Professor Dean said, and from trying to utilize the forces that he recognizes, I certainly am sure they will accomplish a great deal. I was thinking that last year's address and this year's address both touched quite forcefully upon that same aspect—the benefits of team work. It has come to be recognized that agriculture has come to be so thoroughly organized, so thoroughly inter-dependent—the different forces of it—that when we all unite together we can accomplish things that we would not have dreamed of years ago.

That of course does not in any way mean that we cannot disagree. It doesn't mean that there may not be dangers from too much cooperation. I myself thoroughly enjoyed that thought-provoking article presented at the Chicago meeting on organization of research by Dr. W. M. Wheeler. And while I think that we must, to a large extent, utilize the forces prescribed last year by Dr. Newell, and this year by Professor Dean, I think there is a great deal for us to think over very thoughtfully in Professor Wheeler's address; and when we have considered them together we will find the viewpoints are not so diametrically opposed to each other as might appear on first thought.

Mr. P. J. Parrott: Professor Dean selected a splendid subject for his address, and he discussed it in a manner which I am sure meets with the approval of all who heard him. More serious attention should be given to his suggestions, but as other members have dwelt on them, it is hardly necessary for me to prolong the discussion. However, I do wish to express my hearty approval of the desirability of more cooperation between individuals in different state institutions, as well as with those in adjoining states who are interested in similar problems. The cooperative project among phytopathologists and entomologists to determine the value of dusting and spraying to combat apple pests, and the summer meeting of interested workers and fruit-growers impressed me with the great need of more such activities in all areas of the country. These efforts promote friendly relations among scientific wokers and provide opportunities for the exchange of ideas and consultation. They can hardly fail to stimulate better methods in planning and conducting experiments and to encourage greater caution in interpreting experimental results. Then again, farmers enjoy these

field meetings, and I believe there are great possibilities in large co-operative efforts to impress the public with the value of entomological activities.

Other points might be discussed, but Professor Dean presented them very clearly. Our members should take them all to heart and put as many of them as possible into practice.

VICE-PRESIDENT ARTHUR GIBSON: If there is no further discussion, I will say in behalf of the Canadian entomologists that we appreciate very much indeed the address of President Dean, particularly as it relates to the subject of cooperation. At the corn borer conference recently held at Sandusky, Ohio, a large number of entomologists from the United States and Canada met and straightened out many difficulties. This is only one example of what can be accomplished by cooperation.

President Dean resumes the chair.

PRESIDENT GEORGE A. DEAN: The next paper is by C. H. Hadley.

OUTLINE AND PROGRESS OF WORK BEING CONDUCTED AGAINST THE JAPANESE BEETLE, *POPILLIA JAPONICA* Newm.[1]

By C. H. HADLEY, *Riverton, N. J.*

For several years, appropriations have been made annually by Congress and the States of New Jersey and Pennsylvania for the purpose of at first, exterminating the Japanese beetle, and later, when extermination seemed impossible within reasonable expenditures of funds, for limiting the spread of the insect.

The general scheme of organization of the work was outlined in a paper presented by the writer at the annual meeting of this Association a year ago,[2] and the plan of work has been followed during the past year substantially as suggested at that time, with some modifications.

SPREAD

The spread of the insect during the season of 1921 has apparently been considerable. The area infested at the close of the season of 1920 was approximately 103 square miles, of which 92 square miles were in New Jersey and the remaining 11 square miles in Pennsylvania. At the close of the season of 1921, the infestation covered approximately 213 square miles in New Jersey and approximately 57 square miles in

(1) Published by permission of the Secretaries of Agriculture of the U. S. Dept of Agriculture and New Jersey Department of Agriculture.
(2) Hadley, C. H., Jour. of Econ. Ent. Vol. 14 (1921) No. 3, pp. 249—253.

Pennsylvania, a total of approximately 270 square miles. While the spread during the past year seems to have been considerable, the infestation as a whole still remains a single compact unit, speaking in terms of area. That is to say, there have not been found as yet any isolated infestations remote from the main infestation. During the past season long distance scouting was carried on throughout the season and over a comparatively large area, but as a result of this scouting no outside infestations were located, Therefore, we believe that the spread to date may be considered to be the natural normal spread of this imported insect in its new environment. On the other hand, in view of the many avenues of distribution open to an insect having the characteristics and habits of the Japanese beetle, it would not be surprising if additional infestations should be found within the next year or two at some distance from the main infestation. During the scouting season it is planned to continue outside long distance scouting and make every effort to locate remote infestations if any occur. In this connection the writer wishes to urge upon all official Entomologists, particularly those located in the States adjacent to the present infested area, the importance of their cooperation in locating and reporting to the Japanese Beetle Laboratory any findings of the Japanese beetle or of insects which they have reason to believe may be the Japanese beetle.

Quarantine

During the past season the quarantine on farm products has been maintained. This quarantine, (No. 48 of the Federal Horticultural Board,) restricts the shipment of farm products and nursery, ornamental and greenhouse products. During the summer of 1921, the product most liable to carry the beetle was sweet corn. Over 200,000 baskets of this product were examined during the summer and over 5,000 beetles removed from the corn. A great deal of time was also spent in inspecting other products but it would appear that the chances of products other than corn distributing the beetles to any great distance are no greater than other avenues of escape which are impossible of control. In view of this fact a revision of the quarantine regulations has been made, effective January 1, 1922. The revised quarantine restricts the movement of sweet corn, lettuce, cabbage, grapes, hay and straw, among the farm crops. The area quarantined for these products comprises the Townships of Palmyra, Cinnaminson, Delran, Riverside, Chester, Mount Laurel, Northampton, Evesham, Lumberton, Westhampton, Burlington, Willingboro, and Beverly in *Burlington County*: City of Camden, Townships of Pensauken, Delaware, Hadden, and Center, and the Borough of Magnolia, in Camden County, in the State

of New Jersey. In the State of Pennsylvania this territory includes Wards 45, 23, 35, and 41 of the City of Philadelphia in *Philadelphia County*: Townships of Bensalem and Bristol in *Bucks County*.

The restrictions placed upon the movement of nursery, ornamental and greenhouse stock, including also soil, compost and manure other than fresh manure, are, we believe, fully as strict as the situation warrants, and it is our intention to make the inspection and certification of these articles sufficiently strict to eliminate as far as is humanly possible every chance of spread of the insect by this means. The area thus quarantined includes that mentioned in the preceding paragraph and in addition in New Jersey; the townships of Florence, Springfield, Easthampton, Medford, and Southampton in *Burlington County*: Townships of Gloucester, Voorhees, Clementon, and Berlin in *Camden County*: Townships of West Deptford and Deptford in *Gloucester County*; in Pennsylvania, Wards 33 and 42 of the City of Philadelphia in *Philadelphia County*: Townships of Cheltenham, Abington and Moreland in *Montgomery County*: Townships of Southampton and Middletown in *Bucks County*.

Biological Investigations

Biological investigations have been and are now being carried on in accordance with the general plan outlined a year ago. Many additional facts relating to the life-history and habits of the insect have been learned. Perhaps the outstanding feature of this work is the fact that, contrary to previous beliefs, the larvae of the Japanese beetle may under some conditions become a serious source of injury. This possibility is fully discussed in a paper being presented at this meeting by Mr. L. B. Smith, who is responsible for the discovery, and it is therefore unnecessary to consider this phase at greater lengths in this present paper.

Further studies of larval habits have also shown that the distribution of this species is not by any means limited to the heavier soil types. Studies of soil types in relation to larval distribution indicate that the insect can and will propagate in practically any soil type represented in New Jersey or Pennsylvania which will support vegetation.

Data accumulated have also substantiated the previous statements regarding the status of the beetle as a leaf eating pest of considerable importance. Briefly it may be said that the potential seriousness of the insect as a pest in this respect is in direct proportion to the intensity of numbers of the insect in any given locality. There has nothing as yet developed to give reasonable grounds for belief that the insect has reached the limits of its capabilities as a pest of orchard and shade trees. Furthermore it also appears that the insect may under some conditions become a pest of some importance to vegetable crops.

That phase of the biological work having to do with the importation and colonization of natural parasites has progressed fully as satisfactorily as was anticipated. Two species of parasites have been received from Japan in quantities sufficient to possibly permit natural colonization another season, providing the material on hand successfully survives the coming winter. One predaceous species received in considerable numbers this year from Japan has demonstrated its ability so far to survive conditions obtaining in the Riverton district and this species will possibly also be colonized the coming season. Reports from our men in Japan indicate that they will be able to supply us with large numbers of at least one and possibly two more parasitic species during the coming season.

Among the native species parasitic upon related insects, it has been learned that some may to a greater or lesser extent, attack the Japanese beetle. Several species of white grub parasites were successfully brought in considerable numbers last spring from Illinois and apparently are suited to conditions existing in the Riverton district, and it is believed that some of them may in time become a factor in the natural control of the Japanese beetle.

Grub Insecticide Investigations

Satisfactory progress has been made in the study of methods of attacking the insect in its larval stages. The fact that the larvae may become a serious menace to lawns, golf courses and other favorable situations, as reported by Mr. Smith, emphasizes the necessity for continuing the investigations now under way toward the finding of satisfactory control measures to meet these conditions.

Comprehensive experiments are also being conducted in an effort to develop a means of freeing from infestation by the grub nursery stock shipped with soil about the roots, such as the various conifers. This is one of the most important ways by which the insect may be distributed long distances, by reason of the fact that it is impossible to satisfactorily inspect such stock without removal of the soil.

Beetle Insecticide Investigations

Considerable progress has been made in the work looking toward the development of satisfactory methods of killing the beetle by means of sprays. A paper presented at this meeting by Messrs. Leach and Brinley of the Japanese Beetle Laboratory reports the use of soap solutions as contact sprays against the beetle. The best results were obtained with the use of a sodium soy bean soap, and under certain conditions a contact spray of this material gives very satisfactory results.

Satisfactory progress has been made in the testing of arsenical spray materials against the beetle, and a paper presented at this meeting by William Moore reports on these investigations. Briefly it may be said that arsenate of lead alone repels the beetle because of the toxic symptoms resulting from the insect eating some of the arsenical. Arsenate of lead alone, because of this fact, does not kill a sufficient proportion of the beetles to result in satisfactory control. In addition to arsenicals various other materials of more or less insecticidal value have been tested out and while a great deal of data has been accumulated and some progress has been made in the development of spray materials other than arsenicals, it is not desirable at this time to make a further report.

Field Work

A considerable amount of large scale experimental spraying has been conducted during the past season and data accumulated on the results. It is believed that during the coming season large scale demonstrations can be carried on to demonstrate the fact that injury from the Japanese beetle can be reduced to a very great extent by proper methods. No further work has been done with large scale control work, such as cyaniding, because of the excessive cost and questionable final value of this type of work.

Summary

To summarize, it may be said that the work under way against the Japanese beetle is progressing satisfactorily. It may be said that the enforcement of the quarantine regulations so far has been presumably effective in preventing long distance spread of the insect, it appearing that the spread so far constitutes the natural spread of an imported insect in a new and exceptionally favorable environment.

The biological investigations including the parasite work have made distinct and important progress. Much additional data have been obtained regarding the habits and reactions of the insect in its present environment, and definite steps toward the liberation and establishment of natural enemies have been made.

The studies and experiments with contact and stomach insecticides for use against the grub and beetle stages of the insect have shown that it is entirely possible to anticipate in the near future practical methods of reducing the actual injury occasioned by this insect to a very considerable extent.

President Dean: The next paper is by William Moore.

THE REACTION OF THE JAPANESE BEETLE TO ARSENICAL SPRAY DEPOSITS[1]

By WILLIAM MOORE, *Riverton, N.J.*

Several years' experience with the Japanese beetle (*Popillia japonica* Newm.) has demonstrated that the adult beetles are "repelled" from the foliage of plants sprayed with arsenicals. Within one or two hours after spraying, most if not all of the beetles which had been present on the plant, have disappeared. During the summer of 1920 and the first portion of the season of 1921, Leach and Brinley conducted experiments which show that this reaction of the beetles is not due to the color, the discontinuity, or the thickness of the spray deposit. The beetles will readily eat plants sprayed with white barium carbonate or lime, black lampblack, orange antimony trisulphide, or greyish brown clay. Clay or lime with coarse size particles was consumed but lead arsenate, ferric arsenate, and zinc arsenate, having in some cases particles so small that the spray deposit could no longer be distinguished on the foliage, acted as repellents.

A crude ferrous arsenate was reported by Davis[2] as having an attraction to the beetles, but the material was found to be non toxic. During the summer of 1920 it was shown that ferrous arsenate precipitated by the use of tri-sodium arsenate was readily eaten by the beetle but proved to be non toxic in cage experiments. Ferrous arsenate precipitated with tri-sodium arsenate contains some ferrous hydroxide which changes over to ferric hydroxide, an antidote for arsenical poisoning. Basic lead arsenate was also found to be eaten by the beetles, but so late in the season that a toxicity test was impossible. In the early part of the season of 1921, basic lead arsenate was tested and found to be practically non toxic to the Japanese beetle.

During the season of 1921 an effort was made to discover why the beetles leave the sprayed plants. Field observations have shown that beetles will feed for a short time upon plants sprayed with acid lead arsenate, ferric arsenate or zinc arsenate, but leave before they have consumed a killing dose. From time to time new beetles will come to the sprayed plants and start feeding, but they also leave before consuming a killing dose. Beetles collected from such plants, and placed in a cage with an unsprayed food plant have lived and acted normally

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[1]Published by permission of the Secretary of Agriculture, U. S. D. A. and the New Jersey Dept. of Agriculture.

[2]Davis, J. J., "The Green Japanese Beetle Problem", Jl. Econ. Ent., Vol. 13, No. 2, April, 1920. p. 194.

[3]The statements made in the above introductory portion of the paper are largely aken from the unpublished notes of Leach and Brinley during the summer of 1920

for eight days. Lead arsenate precipitated from tenth molar solutions of lead nitrate and disodium arsenate was more readily eaten by the Japanese beetle than ordinary commercial lead arsenate. This lead arsenate consisted of about 25 to 30 per cent. basic lead arsenate and the balance acid lead arsenate. Reducing the amount of lead arsenate from 2 lbs. to 1 lb. per 50 gallons increased the amount of feeding on the sprayed foliage, but the amount eaten was not sufficient to cause death. Freshly prepared ferric hydroxide mixed with lead arsenate, thereby decreasing its toxicity, increased the feeding. Aluminum hydroxide, which would not be as effective an antidote, when mixed with lead arsenate only slightly increased the feeding of the beetle on the sprayed foliage. Lime or lead carbonate, which also decreases the toxicity of lead arsenate by converting some of it to basic lead arsenate, increased the feeding in cage experiments. By using gelatin to coat the particles of the lead arsenate its action was delayed and an increased amount of sprayed foliage was eaten by the beetle. From these observations the conclusion was reached that the beetles were repelled either by the taste of the arsenical or by its toxic effects.

It would appear unlikely that the taste of the arsenical causes the beetles to leave the sprayed plants. If such is the case, then the taste of the arsenical depends upon its toxicity, since the beetles will readily eat arsenicals low in toxicity. Powdered burned alum or quinine were eaten, compounds which are surely far from tasteless. One striking experiment showed that the taste of the arsenical probably did not influence the results. Twenty beetles consumed in six days, all the foliage of a smartweed sprayed with the strychnine sulphate at the rate of 2 pounds to 50 gallons. Not a single death resulted. Twenty beetles in six days ate very little of the foliage of a smartweed sprayed with strychnine arsenate at the rate of 2 pounds to 50 gallons, but six of the beetles died. It would require a very discriminating taste to distinguish between strychnine sulphate and strychnine arsenate.

Arsenic is classed as an irritant poison. Almost the first symptoms in higher animals are vomiting and profuse and painful diarrhea. The withdrawal of water from the body results in thirst and a dryness of the mouth and throat, making swallowing difficult[1].

To what an extent these symptoms are developed in the Japanese beetle is unknown, but beetles which have consumed a killing dose or close to a killing dose of arsenic suffer from diarrhea. Should the reaction in the beetle to arsenic poisoning be similar to that in higher animals, pain would be a prominent symptom. A compound which

[1]Sollman Torald—A Manual of Pharmacology—1917, p. 739.

would relieve the pain should increase the feeding of the beetle to a point where it would be killed. Morphine sulphate would be the most logical material to produce this result, but apparently it has no effect since, when used at a concentration as high as 10 pounds to 50 gallons of the spray, there was no marked improvement in the feeding of the beetles. Atropine sulphate, chloral hydrate, aspirin, diethyl-barbituric acid, sodium bromide, lead bromide, and sodium salicylate, were all tested without striking results.

Attention was next directed to that group of substances classed as intestinal sedatives. Bismuth subcarbonate is used on inflamed surfaces, and as an intestinal sedative in cases of diarrhea. This substance was tested in a cage experiment at the rate of 1 pound to 50 gallons of the spray mixture containing 2 pounds of lead arsenate. One hundred per cent. of the beetles were killed in 4 days compared with 12—14 days for lead arsenate alone. The action of bismuth subcarbonate is not due to any specific effect of the metal but largely the mechanic action of the compound in coating over the mucous membranes. The basic salt of a cheaper metal might therefore be substituted for the bismuth. Zinc subcarbonate gave fair results in cage experiments and was then used in a field test. Beetles collected from the sprayed plants one hour after spraying, and placed in a cage with an unsprayed plant, did not feed for 12—14 hours, showing that they had consumed nearly a killing dose of the arsenical.

Coating the particles of lead arsenate with some material which would slow down its action was next tried. Lead arsenate coated with lead oleate, lead stearate, zinc stearate, or lard gave good results in cage experiments. It was necessary to use these materials as dusts since it was difficult to "wet" the particles with water. A small area of smartweed was thoroughly dusted in the field with lead arsenate coated with lead stearate, and the beetles closely observed and collected as they left the plants. At the end of two hours the beetles still present on the plant were collected and the whole collection placed in a cage with an unsprayed smartweed. Within 48 hours 86.2 per cent. of the females and 61.5 per cent. of the males died. Later experiments demonstrated that if the plants are very carefully dusted with lead arsenate alone, that the beetles may be killed. The leaves of the plants must be whitened with the pure lead arsenate by driving the dust directly on the leaves. Lead arsenate or calcium arsenate allowed to settle upon the foliage from a dust cloud will not result in a killing.

These results show that to kill the beetle, one must have either a large quantity of lead arsenate present on the foliage, or have the lead arsenate coated in such manner that its action is delayed, so that in the period of time elapsing between the first bite and the development

of the first symptoms of the poison, the beetles have consumed a killing dose. Based upon this idea sprays were prepared containing 5 lbs. of lead arsenate to 50 gallons plus 1 to 5 lbs. of flour, gelatin, or glue to coat over the particles and delay the action of the arsenic. These sprays spread evenly over the foliage covering the surface with a large dose of coated particles of lead arsenate. Using sprays and collecting the beetles as they left the plants, a kill of 60 to 70 per cent. was obtained under field conditions. Collections of beetles in the field after spraying may be divided into several groups.

First:—Beetles which have not fed on the sprayed foliage, of these from 20 to 40 per cent. of the males and 0 to 20 per cent. of the females will die, probably due to poison they obtain from cleaning their bodies and in particular their mouth parts while the spray is drying.

Second:—Beetles which after feeding fly away within 30 minutes from the time of spraying. In this group 40 to 70 per cent. of the males and 60 to 80 per cent. of the females die.

Third:—Beetles still on the plants 1 to 2 hours after spraying of which, from 50 to 70 per cent. of both males and females die.

In conclusion, the season's work may be summed up as having shown that the Japanese beetle is repelled by the toxic effects produced by having eaten some of the sprayed foliage; that a certain percentage of beetles may be killed under field conditions by the use of large quantities of the arsenical evenly distributed over the foliage; and that in the case of sprays, the even distribution of the arsenical may be obtained by the use of flour, glue, or gelatin, which materials by coating the particles of the arsenical probably increase their efficacy. Whether the use of an arsenical will be successful for large scale control in the field remains to be determined during the coming season.

Summary

Japanese beetles are not repelled from sprayed foliage by the color, physical condition, or taste of the arsenical.

The beetles appear to be repelled by the toxic symptoms resulting from eating some of the arsenical.

Large quantities of the arsenical evenly distributed over the foliage will result in a certain percentage of the beetles eating a killing dose before the toxic symptoms develop.

A certain percentage, particularly of the males, die without having eaten of the sprayed foliage, probably due to spray material obtained in cleaning their bodies and mouth parts.

President George A. Dean: These papers on the Japanese Beetle are now open for discussion.

Mr. Glenn W. Herrick: Is powdered arsenate of lead less effective in controlling this beetle than arsenate of lead in liquid form?

Mr. William Moore: I did not mean to leave that impression. We have more or less passed by the dust because it gives uncertain results. One can get one result one day and another result the next. The dust when applied by the cloud method only covers a portion of the leaf surface, and fails to kill. The beetle fails to eat a sufficient amount before it leaves the plant.

Mr. R. L. Webster: Have you specific data on the grams of arsenate per square meter of leaf surface?

Mr. William Moore: I have not at the present time. We intend to determine it during the coming season.

Mr. N. F. Howard: Our results with the Mexican bean beetle corroborate Doctor Moore's, especially in the case of lead arsenate. In confinement, adults placed on sprayed plants are more easily poisoned in spring and summer than late fall, when very low percentages are poisoned. This does not apply to the larvae however.

President George A. Dean: The next paper on the program is by G. E. Sanders and A. Kelsall.

CHEAPER ARSENICALS AND THEIR USE

By George E. Sanders and A. Kelsall,
Insecticide Investigations, Entomological Branch, Ottawa

In considering cheaper arsenicals, we can pretty well confine our attention to arsenate of lime and white arsenic, since arsenic, in the form of arsenate of lime varies in cost from one-half to three-fourths of that in the form of arsenate of lead or Paris green, while arsenic in the form of white arsenic, varies in cost from one-seventh to one-tenth of that in the form of arsenate of lead or Paris green.

One or the other of these two cheap arsenicals can be substituted for the more expensive ones for the most ordinary purposes, with the exception of—(1) Lead hydrogen arsenate for straight spraying and dusting on tender foliage, and for combining with sulphur dust. (2) Neutral lead arsenate for use on the most tender foliage, and for use in lime sulphur solution where arsenate of lime gives injury when combined with it.

Arsenate of Lime

This material dusts and sticks better than Paris green, is much safer on foliage, and with the exception of its use in paint should wholly replace that well known material.

Arsenate of lime is unsafe when used straight, or in combination with dusting sulphur, on apple, and other tender foliage. With these exceptions arsenate of lime is either equal or superior to lead hydrogen arsenate for the ordinary uses to which that poison is put.

There has been a great deal of controversy as to the comparative values of lead hydrogen arsenate and arsenate of lime in lime sulphur solution. Different experimenters have reported results that are at variance, yet I have no doubt but that all of the results were fairly reported. From our experience backed by chemical investigations, differences in the time that elapses between the adding of the poison and the application of the spray and differences in climatic conditions may throw the advantage as regards arsenical injury either way. If the spray is applied immediately the poison is added, lead arsenate will usually prove the safer. Weather that will cause the spray to dry rapidly also gives an advantage to lead arsenate. Over a period of years, arsenate of lime has given us a slightly safer combination with lime sulphur than lead arsenate. A small quantity of excess lime makes both somewhat safer in a lime sulphur solution. In using arsenate of lead, the greatest safety is obtained by adding about two pounds of hydrated lime to one pound of dry arsenate of lead in water before adding to the lime sulphur solution. In using arsenate of lime, two or three pounds of hydrated lime should be used to each pound of the arsenate of lime. Both may be dumped directly into the lime sulphur solution.

One of the places where arsenate of lime is superior to all other arsenicals now on the market, is in the alkali sulphide and poly-sulphide solutions. In Nova Scotia, a large proportion of the apple growers have, since they abandoned lime sulphur, used a sodium poly-sulphide solution for the calyx spray. There we worked out the following formula which has proved highly successful under Nova Scotian conditions:—One pound soluble sulphur or one quart sulfocide, one-half pound arsenate of lime and five pounds of hydrated lime to each 40 Imperial (50 wine or U. S.) gallons of water. Increasing the amount of arsenate of lime by one-half in this formula, is safe under most conditions.

In all types of Bordeaux mixture, we have found arsenate of lime safe, efficient and very convenient. While white arsenic may be used in Bordeaux mixture at a still lower cost, it is questionable if small growers or those who have to trust the mixing of their spray chemicals to poor types of labor, can find an arsenical that would in any way be more satisfactory than arsenate of lime.

In Nova Scotia, about two-thirds of the arsenate of lime used on apples is applied in copper arsenic dust which is made up for the apple of eighty-five pounds of hydrated lime, ten pounds of finely ground

dehydrated copper sulphate and five pounds of arsenate of lime. Some seven hundred tons of this dust was used on the apple in the Annapolis Valley last season and there is no doubt but that there will be an enormous increase in its use in 1922. A few tons of copper arsenic dust containing, twenty pounds of dehydrated copper sulphate, eight pounds of arsenate of lime and seventy-two pounds of hydrated lime, were used on potatoes during the past year. We have found arsenate of lime absolutely safe, efficient and satisfactory in every way in this type of, what we term mixed copper arsenic dusts.

In addition to the above mentioned uses, arsenate of lime is the best of all arsenicals for straight dusting on such crops as potatoes, cotton etc.

White Arsenic

The base from which practically all arsenicals are manufactured, is of course infinitely lower in cost than any of its products.

We entomologists in the past have for the most part regarded white arsenic simply as white arsenic and have not paid sufficient attention to fineness, the effect of impurities, texture and source of our material. In working out the formulas that I will describe later, we found it almost impossible to get samples of white arsenic from different sources that gave exactly the same reactions.

The experiments of Davis and Turner[1], and Ford and Larrimer[2], show that the metallic arsenic in the white arsenic used by them was a less efficient insecticide than the arsenic in Paris green. We have been using generally a super-fine dust white arsenic, that is caught in a special baghouse, by the Deloro Smelting and Refining Co. In grasshopper baits, this material we have found, is superior to Paris green on an arsenic basis.

In our opinion the efficiency of white arsenic as an insecticide in baits is primarily a matter of fineness; purity being a minor consideration. It must be said here that freedom from impurities will almost as readily decrease as increase the toxic value of white arsenic.

During the past three years, a considerable number of farmers in the Maritime Provinces have been using white arsenic as a poison in Bordeaux mixture. In 1919 and 1920, this was confined to the potato, but in 1921, it was used with entire success on the apple in the 3–10–40 Bordeaux that is generally used on the apple there.

Briefly, the formula for using it is, mix one pound of quickly reacting super-fine white arsenic with one pound of hydrated lime and mix

[1]Experiments with cutworm baits by John J. Davis and C. F. Turner. Canadian Entomologist Vol. L, No. 6, pp. 127—192.

[2]Some factors influencing the efficiency of grasshopper baits. A. L. Ford and W. H. Larrimer. Journal of Economic Entomology Vol.14, No. 3. pp. 292—299

this mixture in ten Imperial (13½ wine or U. S. A.) gallons of water, and in this suspend a sack containing ten pounds of crystal copper sulphate. Stir occasionally until the copper sulphate is dissolved. This poisoned stock solution of copper sulphate is used in the same manner as a straight solution of copper sulphate, diluted and added to a lime solution that is equally diluted. This formula in the 4-4-40 and 5-5-40 used on the potato and in the 3-10-40 used on the apple, has given satisfaction wherever used in the proper amounts per acre. In certain cases where only one-half as much spray as should be applied was used or where the application was delayed until the potato beetle larvae were more than half grown, some complaints were made, but where instructions were followed excellent results were obtained.

The mixture of equal parts of super-fine quick re-acting white arsenic and hydrated lime is now on the market in Nova Scotia, in two pound packages.

We have recently developed a method of using white arsenic in one of the copper arsenic dusts. Following the success of the dust made up of dehydrated copper sulphate, hydrated lime and arsenate of lime both in pest control and low cost, an opportunity developed of still further reducing the cost by using burned lump lime in place of hydrated, finely crystalized copper sulphate in place of the dehydrated, and white arsenic in place of arsenate of lime. This formula reduces the already low cost of copper arsenic dust by around two dollars per hundred pounds.

During the past season, we made around one ton of the white arsenic, lump lime, crystal copper sulphate dust and the results from it were so satisfactory that the Cooperative Fruit Companies intend manufacturing an experimental batch of fifty tons, for their members testing in 1922. Whether the manufacture of this dust gravitates to insecticide concerns, cooperative companies or large growers, the saving will be the same since the method allows them to use the white arsenic direct, the reactions that go to make it safe being obtained by only a trifling manipulation.

We have found it most important to get white arsenic that is adapted to our needs. There is, as we have already stated the widest difference in quickness in reacting, fineness and texture in different lots of material. Fineness does not always indicate speed in reacting. For all of the purposes that I have outlined, a quick reacting material is superior; it must also be of even fineness and capable of passing a screen of 200 meshes to the inch or finer. Some of our most satisfactory samples have, independent of fineness, shown a fine texture or fluffiness that is usually an indication of a quick reacting material. So far as our work

is concerned purity is a secondary consideration. The most satisfactory material that we ever used runs only ninety-four per cent arsenious oxide.

Conclusion

In addition to the above, there are doubtless many other uses to which these low priced arsenicals can be put. The study of lower priced remedies is an important branch of Entomology, for the finding of a means of controlling an insect or a disease is of little value if the material available as a remedy costs more than the damage. The cost of treatment in proportion to the value of controlling pests varies. Some apple spraying and dusting costs from twenty to thirty per cent of the gross value of the control while occasionally potato spraying will cost as low as five or even three per cent of the gross value of the control.

We know of hundreds of insects and diseases that could easily be controlled, but which generally are left undisturbed on account of the cost of control approaching or even exceeding the value of the damage done and every reduction in cost of materials or methods of treatment moves some of these pests from the class that cannot be profitably combatted into the class that can be profitably controlled.

President George A. Dean: Mr. T. J. Headlee will now present a paper,

SOME FURTHER EXPERIENCE WITH CONTACT DUSTS[1]

By Thomas J. Headlee, Ph.D. and W. Rudolfs, Ph.D.[2]

Introduction

The writers are not attempting in this paper to set forth a finished piece of work but, in view of the large interest now existing in contact dusts, have thought it well to give an account of some data obtained both from the field and the laboratory in the hope that such action might help to hasten the day when the actual worth of contact dusts is known. The senior author was led to undertake these studies because of the tremendous demand on the part of potato growers for a dust method of controlling the pink and green aphis (*Macrosiphum solanifolii*) of potato and tomato.

[1]Paper No. 73 of the Journal Series, N. J. Agricultural Experiment Stations, Department of Entomology.

[2]The chemical determinations have been made by Dr. Rudolfs, who since Sept. 16, 1921 has been filling the position of Bio-Chemist in Entomology at the N. J. State Agricultural Experiment Station.

All mixtures were made at the laboratories. The clay referred to is in all cases Milltown Ball Clay No. 9, dried and ground to a mesh mostly exceeding 200. This is a more or less colloidal clay mined locally and so far as the writers know not reliably analyzed. The calcium oxide referred to is in all cases the best grade of Palmer selected stone lime ground to about 200 mesh. The grinding machines employed were the common ball mills used in ceramics. The nicotine in all cases is derived from "Black-leaf 40." The calcium hydroxide referred to is in all cases a good grade of commercial hydrated lime. The Sanders' dust was secured from Riches, Piver & Co., and consisted, according to the manufacturers, of dehydrated copper sulphate, calcium arsenate and inert ingredients. The nicotine was introduced into the particular dust mixture concerned and ground in in the ball mills above referred to.

Two sets of investigations form the subject of this paper. They are concerned with the determination of the following points:—

(1) The relative effectiveness of nicotine delivered as a dust and as a liquid spray;

(2) The disadvantages of nicotine delivered as a dust as compared with nicotine delivered as a spray;

(3) The advantages of nicotine delivered as a dust over nicotine delivered as a spray·

(4) The relative value of different dusts as carriers for nicotine.

The field work was devoted entirely to the pink and green aphis of the potato and tomato, while the laboratory work was concerned with the rate and the amount of nicotine delivered from the different dust carriers.

Table I will serve to set forth the data relative to the killing power of nicotine delivered as a dust and as a spray and will serve to show some of the disadvantages of dust as compared with spray.

TABLE I.—TABLE SHOWING THE RELATIVE EFFECTIVENESS OF NICOTINE DELIVERED AS A DUST AND AS A SPRAY AND THE LENGTH OF PERIOD OVER WHICH THE KILL EXTENDS WHEN NICOTINE IS USED AS A DUST. TESTS WERE MADE ON M. SOLANIFOLII ON AMERICAN GIANT POTATOES.

Date of treatment	Composition of the dust % Clay	CaO	Bl. L. 40	Nicotine	No. of lbs. per acre	Method of applying
6/23, 1921	86.7	8.6	4.7	1.88	50	Niagara Engine duster
6/23, 1921	88.8	8.8	2.4	.96	50	Niagara Engine duster
	water	soap				
6/25, 1921	98.8	1.0	.23	.09	100 gals.	Engine potato sprayer
6/25, 1921	98.5	1.2	.3	.12	100 gals.	Engine potato sprayer
6/25, 1921	98.5	1.2	.3	.12	100 gals.	Engine potato sprayer

Hours of treatment and % killed					
First Count		Second Count		Third Count	
Hours	% killed	Hours	% killed	Hours	% killed
24	46.6	48	87.0	72	76.3
24	32.7	48	83.8	72	69.3
2	78.2				
24	84.6				
24	85.1				

The above table serves to show that a 2% nicotine clay calcium oxide dust kills 87% of the plant lice, while under the same conditions nicotine delivered as a spray kills very slightly over 85%. It also shows that a 1% nicotine clay calcium oxide dust kills nearly 84%. This table shows that nicotine dust kill reaches its maximum between 24 and 72 hours after application, while nicotine delivered as a spray reaches a high point of kill within the first 24 hours after application and that the vast bulk of its kill is accomplished within the first 2 hours. If rain falling within the period covered by the kill of the dust should promptly put an end to the nicotine dust activity this long period of kill would be a decided disadvantage to the employment of nicotine dusts. As a matter of fact a 1.88% nicotine clay, calcium oxide dust destroyed about 87% of the aphis within an exposure of 48 hours, and a 3.64% nicotine clay calcium oxide dust destroyed 66.6% of the aphis after an exposure of 8 hours at which time a heavy rain fell. When we take into consideration the fact that with a percentum of nicotine 1.76% larger the kill is 20.4% less when rain interfered, we are compelled to conclude that rain coming within the period of kill constitutes a very serious interference with the effect of nicotine delivered as a dust.

Experience covering several years in the application of nicotine as a spray shows that using a mixture composed of 1½ pints of "Black leaf-40," 8 pounds of soap and water to make 100 gallons, the acre cost for lice treatment should, with the present cost of nicotine, range from $3.50 to about $4.00. The cost may be distributed as follows, not taking into consideration the machine charge;—Nicotine $2.34 (wholesale) or $2.91 (retail), soap 40c, man labor 50c, horse labor 25c, total $3.49 or $4.06. Experience has shown that to get a kill with nicotine delivered as a dust comparable to that obtained with nicotine delivered as a spray, from 30 to 50 pounds of material is necessary per acre. The cost of dusting will, therefore, range from $4.75 to $7.50, depending upon the amount of dust used per acre. The cost may be distributed as follows;—Dust material 30 pounds to the acre $4.50 or 50 pounds to the acre $7.50, man labor 17c, horse labor 8c, total $4.75 or $7.70. In making these calculations on both dust and spray it is assumed on the basis of experience that one man and a team together with the proper machinery can spray 8 acres a day or dust 24 acres a day.

It thus appears that nicotine delivered as a dust suffers from two serious disadvantages—rain falling within the period of kill (the first 72 hours) seems greatly to reduce if not entirely to stop the work of the nicotine dust, and the application of nicotine in a dust form at strengths sufficient to make it as effective as the same substances delivered as a spray costs much more per acre.

The advantages of nicotine delivered as a dust over nicotine delivered as a spray are mainly concerned with the speed at which the acreage can be covered and the freedom from the necessity of securing water supply nearby.

The disadvantage of nicotine delivered as a dust as above set forth must in all probability be met primarily through discovering a carrier which will deliver the nicotine at a more rapid rate and in larger amounts, or through the discovery of a carrier which will by attaching itself more closely to the body of the insect render the nicotine which it does deliver more effective, or through the discovery of a carrier that will operate along both these lines.

Table 2 will serve to show the results of certain field tests made with different carriers.

TABLE II.—TABLE SHOWING THE EFFECT OF CERTAIN NICOTINE DUSTS ON MACROSIPHUM SOLANIFOLII ON AMERICAN GIANT POTATOES AND ON TOMATOES

Date of treatment	Composition of Dusts: Material	%	Material	%	Material	%	Material	%	No. of lbs. per acre
6/23, 1921	Sanders' dust	97.6			Bl. L. 40	2.4	Nicotine	.96	25
"	Clay	88.8	CaO	8.8	"	2.4	"	.96	50
7/27, 1921	"	84.4	"	9.3	"	6.3	"	2.52	50
"	$Ca(OH)_2$	77.5	"	15.5	"	7.0	"	2.8	50
"	Clay	78.4	$Ca(OH)_2$	14.7	"	6.9	"	2.76	50

Method of applying	Hours after treatment and % killed: Hours	%	Hours	%	Hours	%	Remarks
Niagara Engine Duster	24	4.	48		72	62.6	No rain
" " "	24	32.7	48	83.8	72	69.3	" "
" large hand "					60	64.7	Light rain 6 hours and heavy rain 30 hrs. after treatment
" " "			48	59.3			Heavy rain 8 hrs. after treatment
" " "			48	19.0			Heavy rain 8 hrs. after treatment

In dealing with the pink and green aphis on potato and tomato it seems useless to consider a higher percentage of nicotine than 2% because the cost of the material becomes impracticably high. There is, however, no doubt that as the charge of nicotine is increased the kill of the lice also increases within the limited period, but the increase in kill is not in proportion to the increase in cost. This fact is shown in Table 3.

TABLE III.—TABLE SHOWING EFFECT ON M. SOLANIFOLII OF INCREASING NICOTINE STRENGTHS AND OF INCREASING THE CaO USED ON TOMATOES

Date of treatment	Composition of dust Clay	CaO	Bl. L. 40	Nicotine	No. of Lbs. per acre	Methods of applying.
7/27, 1921	83.6	9.4	7.0	2.8	50	Niagara large hand duster
7/27, 1921	76.4	14.5	9.1	3.64	50	" " "
7/27, 1921	71.1	17.8	11.1	4.44	50	" " "
7/27, 1921	62.4	24.3	13.3	5.32	50	" " "

% killed	Hours of treatment	Remarks
64.7	48	Light rains in 6 hrs. and heavy rains 30 hrs. after treatment
66.6	48	Heavy rain 8 hrs. after treatment
79.7	48	" " " " "
87.8	48	" " " " "

Improvement in nicotine delivered as a dust must apparently be sought not in the direction of increasing nicotine percentages but in better utilization of the 2% or less which comes within the range of reasonable practice. With this point in view the determination of the rate and amount of nicotine delivered from different carriers was undertaken. Ten grams of each of the nicotine impregnated dusts were placed in a glass container and a stream of air conditioned to 80° F and 73% relative humidity drawn through the dust at the rate of one liter per minute. The results of this work, insofar as the work was complete at the time of the preparation of this paper are set forth in table No. 4.

TABLE IV.—TOTAL PERCENT NICOTINE GIVEN OFF IN HOURS. (ALL MIXTURES IMPREGNATED WITH 2% NICOTINE)

No.	Mixture								
1	Clay	Percent	0.17	0.35	0.74	1.14	1.48	1.94	
		Hours	24	48	96	144	192	240	
2	Clay + 5% CaO	Percent	1.08	2.74	4.22	6.04	8.32	10.1	
		Hours	23	41	89	137	185	133	
3	Clay + 5% Ca $(OH)_2$	Percent	1.03	3.21	4.50				
		Hours	19	59	72				
4	Ca $(OH)_2$	Percent	2.70	5.41	11.46	14.19	16.81		
		Hours	23	45	91	115	139		
5	$Ca(OH)_2$ + 5% CaO	Percent	3.82	9.92	15.96	22.46	27.87		
		Hours	16	40	65	89	11		
6	Sanders' Mixture	Percent	1.65	3.36	7.75	12.44	15.63		
		Hours	24	48	72	96	120		
7	Sanders' Mixture + 5% CaO	Percent	.627	4.22	7.86	10.716	13.68		
		Hours	14	38	62	86	110		
8	50 Clay + 50 CaO	Percent	1.37	5.30	9.69	13.23	16.49	18.91	20.51
		Hours	5	21	45	69	93	117	141
9	50 CaO + 50 $Ca(OH)_2$	Percent	2.22	7 18	13.85	19.26	24.28	28.44	
		Hours	5	21	45	69	93	117	
10	CaO	Percent	2.96	7.64	16.47	20.63	25.31	28.78	
		Hours	5	21	45	67	91	115	

Examination of this table will serve to show the mixtures giving off nicotine in an ascending series as follows;—

Clay, Clay + 5% Calcium oxide, Clay+5% Calcium hydroxide, Sanders' Mixture, Sanders' Mixture + 5% Calcium oxide, Calcium hydroxide, Calcium hydroxide + 5% Calcium oxide, Clay + 50% Calcium oxide, Calcium hydroxide + 50% Calcium oxide and Calcium oxide.

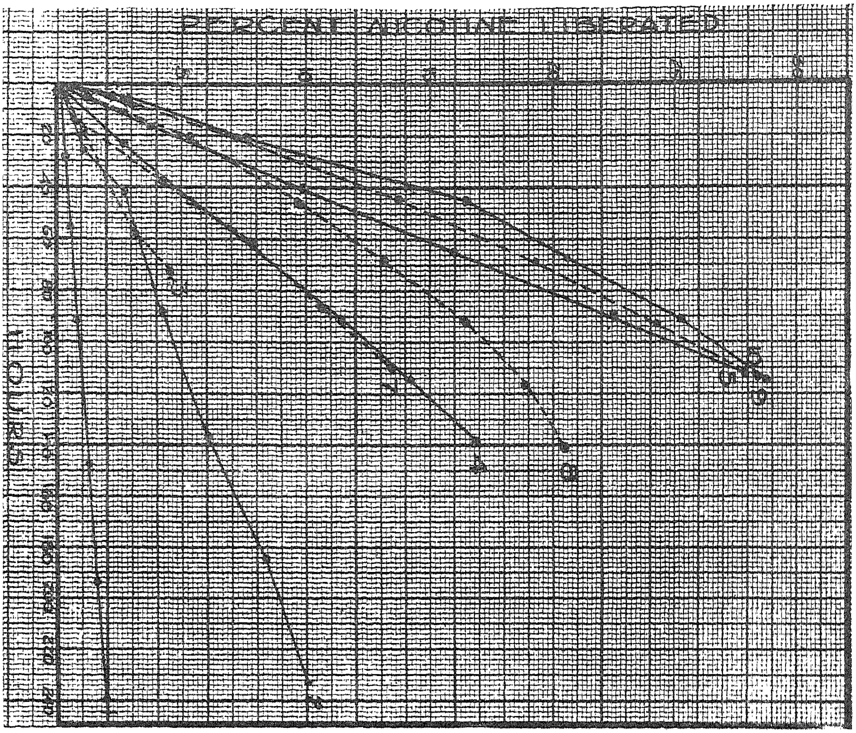

Fig. 1. Diagram showing percent nicotine liberated after definite periods. Legend: 1 = Clay; 2 = Clay + 5% CaO; 3 = Clay +5% $Ca(OH)_2$; 4 = $Ca(OH)_2$; 5 = $Ca(OH)_2$ + 5% CaO; 7 = Sanders' mixture +5% CaO; 8 = Clay + 50% CaO; 9 = $Ca(OH)_2$ + 50% CaO; 10 = CaO.

Two striking features appear in these tests—the first is found in the fact that none of the mixtures throw off 25% of the nicotine within the first 72 hours, or the period of kill. The second is that the clay Calcium oxide mix throws off only about 4% of its nicotine within the period of kill and in spite of that fact seems to be one of the most effective mixtures tried in the field. Of course, in the field tests the amount of calcium oxide used was at least 8½% instead of 5% used in the laboratory tests.

SUMMARY

The following conclusions may be drawn from the data contained in this paper;—

(1) That proper dust carriers impregnated with a 2% nicotine are as effective in control of the pink and green aphis on potatoes as is nicotine delivered in a liquid form;

(2) That nicotine delivered as a dust has the following disadvantages—

(a) The period of kill is much longer than that necessary for nicotine delivered as a liquid, thus rendering the work of the dust liable to serious interference by rainfall;

(b) The cost of controlling aphis with nicotine dust is materially larger than the cost of controlling it with nicotine delivered as a liquid.

(3) That the advantages of nicotine delivered as a dust are primarily concerned with the increased speed in covering large acreages and the freedom from the necessity of a nearby water supply;

(4) That there occurs in all carriers, with which the writers have experimented, a tremendous waste of nicotine;

(5) That the improvement of nicotine dust is to be sought in the more rapid evolution of the 2% or less of nicotine, which is within the range of reasonable practice, or in the delivery of such nicotine as is evolved in close contact with the bodies of the lice, or in developing along both these lines.

MR. WILLIAM MOORE: Last year I pointed out that nicotine may be absorbed by clay. Professor Headlee's work proves that this actually occurs. His results apply to his clay, but not to other clays. I have on my desk 6 or 8 different clays; one from Professor Headlee, another from Professor Sanders, etc. I have been testing them in different ways, not particularly from the standpoint of nicotine, but in other ways. Professor Headlee's does not absorb nicotine as much as some of the other materials. The most interesting clay from our point of view is one from Georgia; I have 2 vials here that I will pass around. They have both the same nicotine content made up according to one of Professor Headlee's formulae and contain calcium oxide. In the light-colored clay, if you will smell it, you will find little or no odor of nicotine. There is 2% there but you cannot smell it. The other sample is Professor Headlee's clay, and the odor of nicotine is quite noticeable. The white clay comes from the south and ties up the nicotine tight, even in the presence of calcium oxide.

MR. W. E. BRITTON: I would like to ask Dr. Headlee if he has tried it with potatoes?

MR. T. J. HEADLEE: No. We tried it last year with apples.

PROFESSOR GEORGE A. DEAN: The next paper is by P. J. Parrott.

CONTROL OF SUCKING INSECTS BY DUSTING

By P. J. PARROTT, *Geneva, N. Y.*

Among the problems of pest control that confront the orchardist and general farmer, those bearing on dusting continue to attract attention. In a previous report the writer presented an outline of the scope and nature of his activities with respect to dusting, and announced some preliminary results relative to the effectiveness of materials in powdered form in controlling certain injurious insects. The present paper summarizes the results of experiments in continuation of previous work, considering especially the susceptibility of apple red bugs and various species of aphids.

THE APPLE RED BUGS

In the experiments with the bright red bug (*Lygidea mendax* Reuter) and the dark red bug (*Heterocordylus malinus* Reuter), dusting mixtures containing 0.25, 0.50, 1.0, and 2.0 per cent nicotine, respectively, were toxic to the insects. The preparations with the highest amounts of nicotine gave, on an average, more uniform results and displayed higher killing power than those containing the smaller ratios. Mixtures with 0.25 per cent nicotine are probably too weak to obtain satisfactory control. Dusts containing 0.5 or more per cent nicotine should be used in rather liberal amounts and applied with care to destroy the majority of the insects and to avoid high dosage cost. Prevailing conceptions of dosage requirements for typical bearing orchards tend to underestimate the quantity of material necessary to accomplish effective results.

Efficient dusting mixtures against red bugs require a larger nicotine content than spraying mixtures, which makes the dosage cost for dusting higher than that for spraying. Dusting requires less time than spraying, resulting in appreciable economies in time and labor. At prevailing prices for materials dusting is more expensive than spraying. Considering the needs of average growers and cost of labor and materials, the apple red bugs can be more effectually and economically controlled by spraying than by dusting. In large commercial orchards dusting could doubtless be used to great advantage in a supplementary capacity to the usual spraying operations.

The Currant Aphis

Dusting and spraying experiments with the currant aphis (*Myzus ribis* Linnaeus) were conducted in a planting of 500 currant bushes, which provided for 100 plats of 5 plants each, thus permitting frequent tests of the different materials. The spraying mixture was composed of 1 pint of nicotine sulfate to 100 gallons of water to which were added 6 pounds of soap. The dusting preparations contained 0.50, 1.00, and 2.0 per cent nicotine, respectively, sulfur-lead arsenate (90–10) being used as the carrier of the nicotine. Each plat received three treatments, dusting material being applied at the rate of 1 pound per bush, and the spraying mixture at the rate of 2 gallons per bush.

Both dusting and spraying mixtures afforded efficient protection. All the treated plants contrasted strongly with the untreated plants, which displayed numerous discolored and distorted leaves that began to drop during midsummer. The foliage of the treated plants was more abundant and adhered to the plants long after the checks had been completely defoliated.

The dusting preparations showed a high rate of toxicity to the currant aphids. The condition of the foliage containing 0.5 per cent nicotine was not quite as satisfactory as that of the vines dusted with preparations containing 1 and 2 per cent nicotine, respectively. A small percentage of the leaves showed injury, but the curling was not of the severe type exhibited by the checks, and there was little, if any, premature defoliation.

The Cabbage Aphis

The experiments with the cabbage aphis (*Aphis brassicae* Linnaeus) provided for tests with dusting and spraying mixtures with different ratios of nicotine, in which all available types of machines for applying liquid and powdered insecticides were used. Soap and nicotine at standard strength, sulfur-lead arsenate (90–10) and lime dusts, containing 0.5, 1.0, and 2.0 per cent nicotine respectively, were toxic to the cabbage aphis. Two applications gave excellent control, resulting in yields of cabbage which were from 4 to 6 tons per acre according to the kind of treatment in excess of those of the check plats.

From the standpoint of economy and effectiveness, the most satisfactory treatment was a lime preparation (calcium hydrate) containing 2.00 per cent nicotine, applications being made at the rate of 20 pounds per acre with a "hand bellows duster." With power dusting machinery, from 35 to 40 pounds of material were required to secure effective control. Considering the results as a whole, dusting appears to be a very promising system of treatment for controlling the cabbage

aphis. It has made a strong appeal to leading cabbage growers in this area who heretofore have been very lukewarm towards spraying as a method of combating the aphis. In the immediate vicinity of the experiments it has been estimated that dusting materials to the value of approximately \$8,000.00 were applied to cabbages.

For the control of cabbage aphis and cabbage worms we prefer, for the present, the formula which provides for 5 pounds nicotine sulfate, 15 pounds of powdered lead arsenate or calcium arsenate, and 80 pounds of hydrated lime. If the caterpillars are not very numerous, it is believed that the arsenical may safely be reduced to 10 pounds.

The Potato Aphis

Of the various insects considered in our experiments, the potato aphis (*Macrosiphum solanifolii* Ashmead) was the most difficult species to combat satisfactorily. It is apparently not as susceptible as the foregoing forms to common insecticides, and the dense foliage and matting of the vines constitute formidable obstacles to effective treatment which can only be overcome by painstaking work.

On the basis of the insects infesting the tips of the growing shoots, dehydrated copper-lead arsenate, containing 2 per cent nicotine, killed 52.3 per cent of the aphids at a dosage of 50 pounds per acre, and 83.2 per cent at a dosage of 90 pounds per acre. Nicotine and soap, using 100 gallons per acre destroyed 85.5 per cent of the aphids.

Notwithstanding the fact that many insects in some of the plats escaped, it should be noted that all the applications checked appreciably the rapid development of the aphids on the growing tips of the vines, which seemed to afford noticeable protection to the leaves. The plats that were left untreated displayed much discolored, withered foliage as the result of the uninterrupted feeding and breeding of the aphids. And one unacquainted with the plans of the tests had little difficulty in distinguishing the untreated plats from the treated plats.

Conclusions

In view of the data obtained from the foregoing experiments it is concluded that apple red bugs and certain aphids may be effectively controlled by thoro dusting with sulfur-lead arsenate or calcium hydrate containing nicotine sulfate. The outstanding advantage of dusting is speed of operation which effects noticeable economies in time and labor. A serious drawback is the high cost of the preparations, due chiefly to the large amount of nicotine required to make effective mixtures. Notwithstanding the economy in time and labor, dusting on the basis of existing prices for materials and labor has generally been more expensive than spraying, except possibly in the treatment of cabbages.

One means of effective economy is to employ mixtures with the minimum amount of nicotine necessary to secure satisfactory control. The experiments as outlined indicate that for certain species of insects lower ratios of nicotine may be used than now generally prevail. Of vital importance in furthering an extensive employment of dusting for the control of sucking insects is the need of less expensive materials which function effectively as contact insecticides.

Mr. Glenn W. Herrick. These experiments are interesting to me as they point out clearly that in nearly any spraying operation, a certain number of the insects escape, no matter how thoroughly you may carry on the work. The efficiency of almost any insecticide in the field seems to depend in the final analysis on the effectiveness with which it is applied

President George A. Dean. The next paper on the program is by J. S. Houser and C. R. Neillie,

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AN ACCOUNT OF THE SUCCESSFUL USE OF THE AEROPLANE IN DUSTING TALL TREES INFESTED WITH LEAF EATING CATERPILLARS.

By J. S. Houser and C. R. Neillie

(Withdrawn for publication in National Geographic Magazine, March, 1922.)

Mr. E. G. Kelly. What is the expense of this machine?

Mr. J. S. Houser. The greatest item of expense lies in the original cost of the plane, but when you consider that a Curtis plane can in these times be procured for fifteen thousand dollars, and that some of the liquid spraying machines used in New England cost five thousand dollars and over, the comparison is not so much out of the way, after all. The work that one can do in a day's time with an aeroplane equipped as was ours, or equipped as a real machine for the work should be equipped, will greatly exceed that of a liquid sprayer. Thus the saving in time and labor would more than offset the original excessive cost of the machine.

Mr. F. C. Craighead. What is your idea of the best wind conditions for application?

Mr. J. S. Houser. We used a crossing wind. Under other conditions you might want to fly directly into the wind. We found in our trial flights at McCook field that we could get an excellent spread of the poison by flying into the wind, and that would allow one to fly higher than otherwise.

Mr. F. C. Craighead. How far to the side did you fly?

MR. J. S. HOUSER. Fifty-three yards from the grove, and the dust covered the windward and leeward side as well. I might have said that the wind was blowing at the rate of eight to eleven miles an hour. The grove was three hundred and twenty-five feet wide.

MR. F. C. CRAIGHEAD. How far beyond the grove did the poison extend?

MR. J. S. HOUSER. Particles carried from five to eight hundred feet beyond, but most of it settled in the grove.

MR. F. C. CRAIGHEAD. With one application can you cover a strip five hundred feet wide?

MR. J. S. HOUSER. Three hundred and twenty-five feet—and then some drifted on over. The farthest distance of drift I should say was perhaps one thousand feet.

MR. W. C. O'KANE. I want to ask whether there were any indications that any of the caterpillars died from the wilt disease. I have seen heavy infestations by the maple worm enormously reduced inside of 48 hours by this disease. The conditions of infestation and the heavy defoliation of the trees as shown on the slides indicate conditions that would be favorable for an outbreak of the wilt disease.

MR. J. S. HOUSER. I have no evidence that this disease was present in this case. An examination of caterpillars of the same species on trees nearby that were not sprayed showed that they were perfectly healthy, although the conditions as to defoliation were the same.

SECRETARY A. F. BURGESS: I am very glad to have heard this paper. Last summer Mr. Houser invited me to witness the test, but it had to be started a few days earlier than was planned, and I did not have sufficient time so that I could be present. The information given is exceedingly interesting, but we should remember that it was carried on under conditions which seem to be extremely favorable for aeroplane work. The ground on which this small area of catalpa trees were growing, was very level, and there were many places nearby where a perfect landing by an aeroplane could be made. Most forest conditions are not as favorable. The weather was apparently favorable, while on large scale spraying operations much adverse weather conditions would probably be encountered. This is not a criticism of the experiments, although I do not believe results similar to these can be duplicated under all woodland conditions. In the gipsy moth work where a large amount of woodland spraying is done, the country is rough and uneven and I believe it very doubtful whether similar results could be secured. The statement made by Mr. Houser concerning the spraying of pasture and corn, is very interesting. I do not believe wholesale dusting of this type could be carried on without encountering many complaints from owners of

pastures. I hope further experiments with aeroplanes will be continued. It is a good line to follow up, but there will be many practical difficulties to overcome before aeroplane spraying will be brought to a state of perfection where it will be practical in rough forest areas.

In regard to the wilt disease, from the amount of defoliation of these catalpa trees and the rapid death of the caterpillars, I have a suspicion that some wilt disease was present.

Mr. J. S. Houser. The catalpa sphinx is a rather watery, flabby caterpillar and begins to decay very soon after death. This, I think, explains the reason why the breakdown of the caterpillars was so rapid. I believe it was the spraying that was responsible for their death.

Mr. William Moore. What was the material you used?

Mr. J. S. Houser. Powdered arsenate of lead.

Mr. H. A. Gossard. I was present at the time this work was conducted, and I would say, regarding the question of wilt, that these caterpillars were not starving at all. There was abundant young foliage on the trees the day the dusting was done. We climbed those trees after the work was done, to the tops of them, and branches were brought down. I really didn't do the climbing but I received some of the branches that were brought down, and the amount of dust that was on them and on everything in the grove made us expect that those fellows would begin to wilt—but not with wilt disease. There wasn't a sign, the day I was there, of any disease with those caterpillars. They were there in abundance and were healthy and were feeding at a great rate. Three days later, Mr. Houser made a report that about ninety-nine per cent. of them was dead.

I think these questions are entirely proper but I don't think anyone who was present and saw the work done, would have any suspicion at all that a bacterial disease attacked those caterpillars. It was something else.

President George A. Dean. The next paper is by Mr. D. M. De Long.

THE BOOM NOZZLE SYSTEM AND THE TRACTION DUSTER AS FACTORS IN GRAPE LEAF HOPPER CONTROL

By D. M. DeLong, *Ohio State University*

The Grape Leaf hopper (*Erythroneura comes* Say) has been a very serious pest in the Erie-Chautauqua grape area along the southeastern shore of Lake Erie for many years. The attacks of these minute insects during several successive summers may be so inconspicuous that the growers may be inclined to regard the pest as a factor of diminishing importance in grape growing, and they are always hopeful that it will

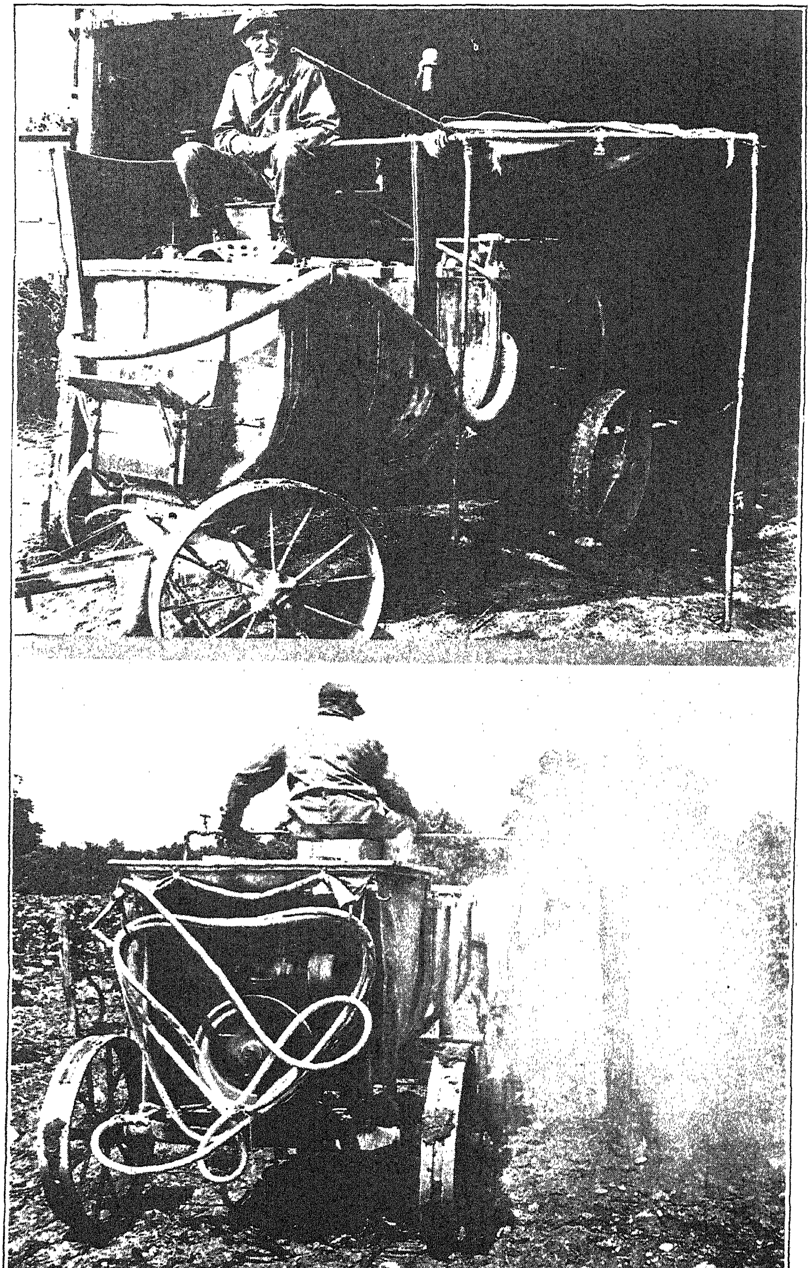
gradually disappear as a pest; but frequently the following season will favor the growth and development of vast numbers of hoppers, which the grower is generally unprepared to combat.

During the seasons of 1920 and 1921 the hoppers have caused great damage to hundreds of acres of grapes in this section, and naturally the areas most severely attacked were those closely approximating woodlands. The serious damage caused by these pests can be realized more fully when it is known that foliage severely attacked dried prematurely and curled up before the grapes had ripened. Consequently many growers were refused markets for their grapes in 1920 at the Welch grape juice plant on account of the red appearance and sour flavor of the partially ripened fruit.

Many of the growers with a large acreage of grapes were totally unprepared to spray when the nymphs appeared in great abundance, and the leaves began to turn yellow. One of the most progressive growers stated that he had neither sufficient length of time, nor enough men to spray with the customary trailer nozzles, and that if he attempted to do so other fruits must go unsprayed. Furthermore, a large percentage of the hoppers would become adults by the time the spray could be applied.

For many years attempts to combat the Grape Leaf hopper and Grape Berry moth with the customary "set nozzles" have been made with varying success. In the old type of sprayer the nozzles are so arranged that the halves of two rows are sprayed simultaneously, thereby permitting the hoppers to escape from the row by way of the unsprayed portion, many of them flying to safety before the spray. In this type the nozzles were set horizontally to the vine on vertical rods at either side of the tank. This arrangement of nozzles had a tendency to push the leaves downward instead of exposing and treating the under surface where the hoppers usually feed.

The boom system with the arrangement of nozzles for spraying one row at a time from both sides and above has been previously used but the nozzles in that case were placed horizontally to the vine and machines were being delivered to the growers in that condition in 1921. Furthermore the lower nozzle was two or three feet above the ground when the spray was applied and the nozzles were all set in the same plane. In view of the unsatisfactory results obtained from this type of set nozzle a rearrangement of nozzles was devised which has given very satisfactory results. This arrangement permitted the operator to be seated on the spray tank holding a $\frac{5}{8}$ inch horizontal pipe about seven feet long, connected with the spray tank and extending over the top of the row. From this horizontal piece of pipe a three foot pipe connected by three feet of rubber hose extended vertically almost to the ground on either side of the row at a distance of about three and one-half feet apart.



Boom Arrangement of Set Nozzles

Upper—Showing arrangement of five nozzles for spraying both sides of row

At first seven disk nozzles were used. One was placed so as to point downward from the horizontal pipe, midway between the vertical pipes, and directly over the grape row. Three nozzles were placed on each vertical pipe, one at the extreme lower end pointed upward at an angle of about 45 degrees, another about a foot and one-half above directed upward and slightly backward, and a third about three feet from the bottom directed upward and slightly forward. The nozzles were fitted to the vertical pipe by means of "T's", and an "Ell", which sufficed in the case of the extreme lower one. The principal disadvantage encountered at the start was the spreading of the vertical pipes on the application of pressure from the pump, preventing a thorough application to the foliage. This was readily overcome by a weight at the end of each vertical pipe, and fully as good results were finally obtained in spraying by removing the upper nozzle on each vertical pipe, leaving only five nozzles arranged as described above.

Three things are important in the construction. First, the lower nozzle should be as close to the surface of the ground as possible, as the lower portions are frequently most heavily infested by the nymphs; second, the nozzles should be upturned at an angle of approximately 45°, but this will vary with the vineyard and a difference of 5° will often cause a 15 to 20% difference in the killing; third, the lateral nozzles should be alternated slightly forward and backward.

The driving spray from the up-turned nozzles raises the leaves and covers the under surface thoroughly, while the nozzle above the vine covers the upper surface. Under sufficient pressure a perfect mist was obtained by this arrangement of nozzles, and observations of the leaves just after spraying proved that the greater percentage of immature hoppers had been hit and killed by the spray.

In the vineyard where this experiment was carried on, the undersides of the leaves were almost covered with hopper nymphs, and an excellent chance was afforded to try out this apparatus on a large acreage.

Comparing the two types of "set nozzle grape sprayers" the boom system has certain advantages over the old type; first, the thorough treatment of one row at a time, enveloping both sides of the vine in a fine driving mist offering little opportunity for either nymphs or adults to escape to safety; second, the up-turned nozzles lift the leaves and thoroughly cover the under surfaces. As compared with the trailer system the economic factors of time and expense are important. It requires more than twice as long to spray with trailer nozzles than to cover the same area twice with the boom system and an extra man is necessary to operate the trailer nozzles. In other words the extra 5 to 10% killed by the trailer system costs as much as the first 80 or 85% which can be obtained by the boom system and is an economic control.

A Preliminary Report of Dusting for Control[1]

The traction duster has been used the past season in an attempt to control the grape leaf hopper. A 2% nicotine dust was used with both Bordeaux and lime. Applications on different plots varied at the rate of from 20 to 75 pounds per acre and it was only at the rate of 60 pounds per acre or more that a decided killing of both adult and nymphal stages was secured. Scarcely a live hopper could be found in some plots and dead leaf hoppers were observed in great abundance under the vines. On other plots treated on the following evening with apparently the same material and the same amount there was only a small per cent of killing. For this reason it is very hard to state what condition caused the killing. The different results obtained may be due entirely to the temperature and humidity conditions and there may have been a difference in the percentage of nicotine in the mixture.

Although a large amount of experimentation will be necessary to determine the conditions of killing, the interesting fact is that an economic control has been obtained by the dust on some plots.

President George A. Dean. The next paper is "Derris as a Promising Insecticide," by R. W. Wells, F. C. Bishopp, and E. W. Laake.

DERRIS AS A PROMISING INSECTICIDE[2]

By R. W. Wells, F. C. Bishopp and E. W. Laake,
United States Bureau of Entomology

There is a distinct demand for an insecticide for use on domestic animals which can be applied in the dry or dust form and be depended upon to give satisfactory control. This is especially true in regard to the control of lice on live stock. The various species of lice seldom become sufficiently numerous to be of marked importance as parasites, except during the winter when the conditions are least favorable for the application of liquids. In an effort to meet this need the authors and their associates have tested a considerable number of dry insecticides under varying conditions and against various external parasites. Among the substances tested was powdered derris. The insecticidal properties of this material were brought to the attention of American entomologists by Messrs. N. E. McIndoo, A. F. Sievers, and W. S. Abbott.[3] As shown by these authors this material has some promise both as a contact and as a stomach poison for insects.

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[1]All materials used in the trial were furnished by the Niagara Sprayer Co. through the kindness of Mr. F. J. Sutton.

[2]Published by permission of the Chief of the Bureau of Entomology.

[3]Derris as an insecticide, Journal of Agr. Research, vol. 17, No 5, pp. 177—200, August 15, 1919.

In our tests of the substance when applied externally on animals and fowls we have seen no indication of any poisonous effects to the host. It is also stated that in factories where the roots are being powdered the employees become covered with the dust and experience no ill effects whatever. It is certain, however, that with a material so toxic it is necessary to proceed rather cautiously until we know more about its effects on the higher animals and man.

The powdered derris roots used in our tests were kindly furnished by the Tobacco By-Products & Chemical Corporation, and is supposed to be from *Deguelia (Derris) elliptica*.

Experiments With Derris Against Mallophaga

In our tests of this material against Mallophaga we treated chickens infested with seven species of lice and cattle infested with the common biting louse of that host (*Trichodectes scalaris*). Where chickens were rather thoroughly dusted with derris the lice were very quickly destroyed, practically all of them being dead the day following treatment. Subsequent examinations extending over a period of six weeks showed no live lice present, thus indicating that the eggs were killed or the young lice destroyed upon hatching. Derris was also tested in suspension in water by Mr. H. P. Wood. Over forty fowls were dipped in a bath containing one-fourth ounce of powdered derris to one gallon of water. Subsequent examinations showed that a few lice were still present on the first and second day after treatment but soon after this all live lice disappeared and none were found on several subsequent examinations. In another test derris was used at the rate of one ounce to three gallons of water. Two and one-half hours after dipping some dead lice were found but a few living ones were present for about two weeks, when all disappeared.

Derris Against the Common Biting Louse of Cattle

A number of experiments were carried out with the dusting of cattle with derris diluted with various amounts of carriers. In the preliminary experiments at Dallas, in which the authors were assisted by Mr. H. P. Wood and Mr. E. E. Wehr, the results against this species were not very satisfactory, but these rather indifferent results were chargeable in a measure to the fact that the calves were not thoroughly dusted. In one test three heavily infested animals were treated with derris and tobacco dust, equal parts, the latter containing about .1% nicotine. The material was applied at the rate of 12.3 grams per animal with a dust can. On the following day all but a few scattered lice were dead. Subsequent examinations showed the presence of a few live nymphs only, thus indicating that probably all adults were destroyed but some

of the eggs escaped destruction. Unsatisfactory results were secured with the use of 8.6 grams per animal of derris and tobacco dust (one to ten) on four other hosts. Five heavily infested calves were treated by dust gun with 3.5 grams per animal of derris and wheat flour (one to three). Four days later a few living lice in all stages were still present. Derris and flour in proportion of one to five was applied with a dust gun on seven additional calves on Feb. 14, the infestation ranging from light to heavy. The final examination of these animals was made on March 9. Four of them appeared to have all lice destroyed while two showed a very few living lice and one a moderate number.

Three animals were treated Feb. 14 and 15 with derris and flour (one to twenty) applied with a shaker can. About one ounce of the mixture was used per animal. On March 9, one of these was completely free of living lice and a few were present on the other two. Five animals were dusted with a hand atomizer on Feb. 14 and 15, using derris and flour in proportion of one to ten, 16.2 grams per animal. On Feb. 16 very few live *T. scalaris* were observed and on March 1 and 9 but a single immature specimen was found alive.

Owing to the fact that sodium fluoride has been shown by us to be very effective against *T. scalaris* when applied in the dust form, and with a view to developing a powder which would be one hundred percent efficient against all lice on cattle, a mixture of equal parts of derris and sodium fluoride was dusted with a gun on 16 calves and yearlings on Feb. 24. About one and three-sixteenths ounces were used per animal. On March 9 and on subsequent dates not a single live louse could be found upon thorough examination.

On May 18, 1920, two calves which were heavily infested with *T. scalaris* were treated at Lafayette, Indiana, with pure derris powder, one ounce per animal applied with a dust gun. All lice were observed to be dead on May 22 and the eggs were apparently killed. On June 5 no living lice were found and all of the eggs appeared to be dead and collapsed. Three other moderately infested calves were treated by shaker can with derris and flour, equal parts. Two received one ounce each and the other one and one-half ounces. Four days after treatment all lice and eggs were apparently killed, and on June 5 not a living specimen was found.

Use of Derris Against Anaplura

The use of derris has been given a fairly extensive test against two of the common sucking lice of cattle, namely *Linognathus vituli* L. and *Solenopotes capillatus* End.

On Feb. 15, 1921, seven calves, most of which were heavily infested with *L. vituli*, were treated. Two of these received derris and flour

one to five, one ounce per animal applied with a gun. Three received derris and flour one to ten, 16.2 grams per animal applied with a gun, and two derris and flour one to twenty, 28.75 grams per animal applied with shaker can. These calves, with the exception of one treated with the 1 to 10 mixture, were examined on Feb. 24. All of the lice were killed on the animals treated with the 1 to 10 and only a few were found on one of those treated with the 1 to 20 mixture. All of the others had a few living specimens present although some of them were weak. On Feb. 24, 1921, 16 calves, most of which were lightly infested with *L. vituli*, were treated with sodium fluoride[1] and derris equal parts with a gun. On March 9 and subsequent dates not a living louse could be found and the eggs were collapsed. At Lafayette, Ind. two heavily infested calves were dusted with pure derris and three with equal parts derris and flour, applied with a shaker about one ounce of powder per animal. Examinations made four and eighteen days later showed no live lice and all eggs collapsed.

On Feb. 14, 1921, two calves with a moderate infestation of *S. capillatus* were dusted with one ounce of a mixture of derris and flour, one to five, with a dust gun. Two days later one of these showed a few alive and the other about fifty percent killed. On March 1, both were apparently free from lice and all of the eggs appeared to have hatched or collapsed. On March 9, however, a group of lice was found near one of the ears. On Feb. 14, a calf was treated with one ounce of derris and flour, one to twenty with a shaker can. Two days later no live lice were found and examination on March 1 showed no living specimens, but several were found to be alive when the animal was examined on March 9. Six calves, each with a light infestation of *S. capillatus*, were treated on Feb. 14 with derris and flour, one to ten, 16.2 grams per host with a dust gun. On March 1, only two living specimens could be found, and on March 9 no adults were present, but several half grown lice were seen. A cow showing a heavy infestation of this species was thoroughly treated with derris and flour in equal parts by means of a shaker on March 1, one and three-fourth ounces of the mixture being used. On March 9 a thorough examination indicated that the lice were completely destroyed. All eggs were either hatched or collapsed.

All of the calves in these tests were associated with other animals and the re-occurrence of specimens in some cases indicates that the animal may have been reinfested from other stock.

A test with derris and flour one to one was made on a dog heavily infested with the sucking louse, *Linognathus setosus* Olfers. The animal was given a thorough treatment with one ounce of the mixture with

[1]Sodium fluoride has been found to have practically no effect on this species.

shaker can. Examinations two days after dusting and subsequently failed to reveal the presence of adults or young, thus indicating complete destruction. Three other infested dogs were dusted with much smaller amounts and all lice and eggs killed. The minimum amount tried on the above hosts was about two grams of a mixture of derris and corn starch (one to three).

Preliminary Tests With Derris Against Larvae of Hypoderma lineatum

A preliminary test of the use of an ointment consisting of one part derris to two parts vaseline applied to the holes of warbles in the backs of cattle indicates that this ointment is as effective as any other material used in this way. Five days after treatment all grubs were found to have been killed and the condition of the cysts was very satisfactory. A wash consisting of one pound derris, four ounces soap and one gallon water applied once with a brush to the backs of infested cattle killed practically all grubs.

Use of Derris Against Fleas

Results from the use of derris against dog and cat fleas were surprising and extremely gratifying. A series of tests were carried out by Mr. H. P. Wood in a dog and cat hospital in Dallas. Dr. Allen Foster, the proprietor, very kindly cooperated in this work. Both dog and cat fleas (*Ctenocephalus canis* and *Ct. felis*) were present.

In the first test which was begun Oct. 28, 1918, three dogs were given a thorough treatment with undiluted derris with a dust gun. On the following day a single living flea was observed. On repeated examinations extending up to Nov. 10th no more living fleas were found despite the fact the dogs were associated with other infested individuals.

Four dogs of three breeds were given a thorough but rather light dusting with derris undiluted and no live fleas were found on them two days later.

A series of tests with several breeds of dogs indicated that the minimum dosage necessary to completely destroy all fleas was .87 grams of a mixture of equal parts derris and corn starch per animal. When the quantity of derris was reduced to .2 grams one hundred percent kill was not realized.

Following these preliminary experiments derris and corn starch in the proportion of 1 to 3 was applied to all of the animals in the hospital at the time—48 dogs and 9 cats. The material was put on along the back and neck of each animal with the thumb and finger. An average of slightly less than two grams per animal was applied. These animals were treated on Dec. 4 and subsequent examinations up to Dec. 10 showed no living fleas.

In order to determine the results of the use of derris on dogs which were not removed from their flea-infested quarters, treatment was begun on three heavily infested animals. Dust was applied on all parts of the animal at the rate of one-half to two and one-half grams. In the case of one of these dogs all fleas disappeared after the second application and none were found subsequently. Probably the cool weather of December held the breeding in check, however. In the other tests live fleas were found about a week after each treatment and the number gradually increased until the next application was made. Three treatments, however, reduced them to comparatively few and the tests were discontinued.

Several cats were treated with about three pinches of derris each. No injury whatever was observed to the hosts and the fleas were all destroyed, although where the cats had freedom some living fleas were picked up a few days after the application and apparently remained on the host.

In one test puppies rather heavily infested with the sticktight flea (*Echidnophaga gallinacea*) as well as the dog and cat fleas, were each treated with one gram of undiluted derris. In a few hours dead dog and cat fleas began dropping off the hosts and the following day all specimens were dead, though many sticktights remained attached.

Summary and Conclusions

Derris powder is satisfactory as a destroyer of Mallophaga on chickens and cattle, but apparently not quite as effective on the latter as sodium fluoride.

It is very effective against Anoplura on cattle and dogs, one treatment accomplishing the destruction of all stages.

The results of its use against fleas on dogs and cats are probably most striking, very small amounts being sufficient to destroy all fleas present.

It appears to be effective for lice and fleas when reduced with from one to ten parts of a carrier to one part of derris.

Mr. H. A. Gossard: Where can we obtain derris commercially?

Mr. F. C. Bishopp: There is no commercial supply now available in this country, but I believe, with a demand for the product, that it will be put on the market. I understand that an English chemical company is now producing it in the East Indies, and furnishing it as an insecticide in South Africa. It is said that they are in position to supply a considerable quantity of it. I don't know that the supply

would be sufficient for all needs that may be created in time, but I am convinced that the production can be greatly increased, with the demand.

MR. H. A. GOSSARD: What does it cost?

MR. F. C. BISHOPP: It costs about a dollar a pound, but perhaps it could be produced considerably cheaper.

MR. L. O. HOWARD: How does this compare with pyrethrum?

MR. F. C. BISHOPP: With nearly all of the pyrethrum group, in the case of fleas at least, there is that stunning property which causes the fleas to come out and drop off, while with derris we get actual destruction of them. Of course the destruction of the insect is important and in that derris is very effective.

MR. N. F. HOWARD: Derris appeared to be superior to a good grade of pyrethrum against the Mexican bean beetle; however, we are not recommending either of these materials for practical use against this insect.

PRESIDENT GEORGE A. DEAN: The next subject is "The Apple Sucker," by W. H. Brittain.

THE APPLE SUCKER

(*Psyllia mali* Schmidberger)

By W. H. BRITTAIN, *Provincial Entomologist for Nova Scotia*

PRESENT DISTRIBUTION

The present known distribution of the apple sucker includes, Austria, Caucasus, Czecho-Slovakia, England, Ireland, Germany, the central and northern part of old Russia, Norway, Sweden, Denmark, Holland and lastly Nova Scotia, where its presence was first detected in 1919. It has also been recorded from Japan and France, but at the present time it is not known to be present or injurious in either of these countries. It is apparently found as far north as the apple will grow and seems to be most serious and abundant throughout the northern range of its host.

HOST PLANT

The insect is recorded as breeding on the European Mountain Ash (*Sorbus aucuparia*) and it occasionally attacks pear and more infrequently quince. From a practical standpoint, however, the apple may be considered the sole host. The fact that it has been reported from a long list of other plants is doubtless due to the habit of the adult insect of seeking shelter on other trees than its real host.

Character of Injury

The injury is almost entirely the work of the nymphs, as the adults do no appreciable damage. Both leaves and blossoms are affected, the latter most seriously, since the insect prefers the blossom clusters for food. Badly infested blossoms shrivel and die and remain hanging to the injured trees for some time. The injury due to these creatures seems, however, to result entirely from the amount of sap withdrawn from the blossoms, there being an entire absence of that "poisoning" effect, that seems to result from the punctures of certain Miridae.

Injury to the foliage falls in four general categories:—

1. Brown withered leaves that may remain clinging to the trees throughout the summer.
2. Green leaves that are sometimes shed in showers about the end of June in infested orchards, apparently due to the work of this pest.
3. Yellow leaves which may begin to fall in mid-June and continue for several weeks.
4. Similar injury to No. 3, but greatly aggravated, which seems to result from spraying injured trees with Bordeaux mixture or dusting them with copper-lime-arsenate dust. The work of the insect seems to render the foliage particularly susceptible to spray injury of this kind and orchards so treated sometimes present a much worse appearance than those left unsprayed.

The insects may be present in large numbers without causing much apparent damage and we are as yet unable to predict what place it will eventually occupy as an apple pest.

Life History

The first emergence of nymphs from the eggs takes place when most varieties of apple are in the so-called "mouse ear" stage, but on very late opening varieties such as Northern Spy, the buds may not have even begun to burst. On the other hand the leaves of the Transcendent Crab are well expanded. The insect hatches first on the earliest opening varieties, there being a difference of as much as four or five days between Gravenstein and Northern Spy, but the emergence does not correspond perfectly, by any means, with the state of development of the buds. The entire hatching period may extend over eleven days. In 1921 the first individuals emerged just one week later than those of *Aphis pomi* De G. and just eleven days previous to those of *Lygus communis* Knight.

The nymphal stage lasts from thirty-one to thirty-six days, the emergence of other adults reaching a maximum about six days after the first individuals are seen and continuing for about eight days thereafter.

Mating takes place within two weeks after emergence and is observed throughout the remainder of the season, but no eggs are laid until late August or September and oviposition continues until freezing weather.

The female prefers the wood of bearing trees upon which to lay her eggs, mostly upon the smaller fruit spurs or shoots. They are not laid with any regularity, but occur with great frequency on the unevennesses of the spurs, around bud-scale scars, among the pubescence of the young growth however. They are sometimes found, but much less often and in much less abundance, upon nursery stock.

Habits

The young on hatching immediately penetrate the buds and seek the axil of the unfolding leaf where they remain until almost fully grown, when they may be found in the open ranged along the flower stalk, petiole or lower side of the leaf. They secrete a copious amount of clear, sticky fluid, which is surrounded by a whitish, opaque, waxy material secreted by a group of pores around the anus. This is often seen in the form of a thread with a globule at the end protruding from the insect's body. In severe cases it drips from the trees on men or horses passing beneath.

The adults feed but little and do no apparent injury. They have a tendency to spread out onto shade or forest trees surrounding the orchard until the acutal number in the orchard is greatly reduced, but return again to deposit their eggs. Orchards sprayed in the spring are soon reinfested by adults flying in from surrounding untreated orchards.

Natural Enemies

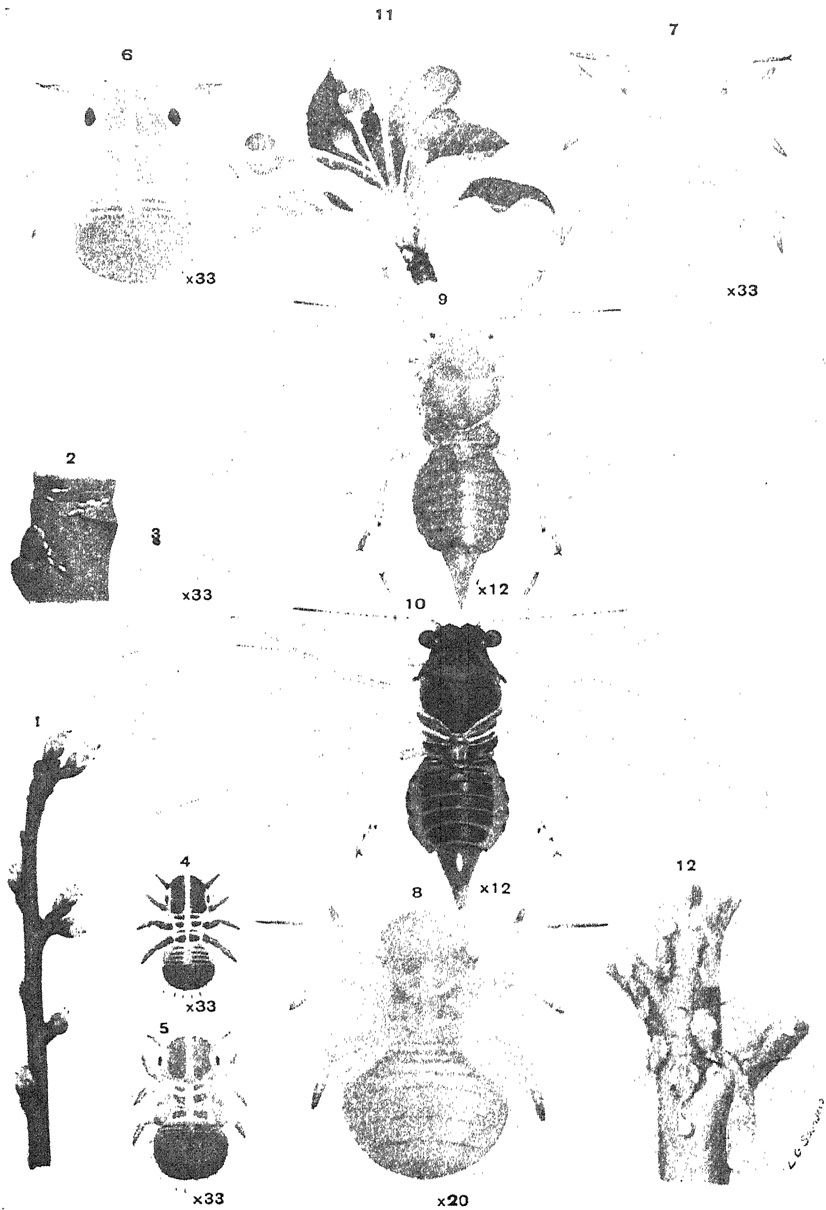
No parasites are known, but numerous predaceous enemies, such as birds, ants, aphis-lions, etc. account for a certain number. This loss, however, is from a practical standpoint, insignificant.

A fungous disease (*Entomophthora sphaerosperma*) has proven much more effective over limited areas, practically wiping out the insect in certain orchards. The disease started in 1920 in a few very heavily infested orchards at the point of original discovery of the pest and was only effective in a few orchards immediately contiguous.

Control

The control experiments may be considered under two headings:—

1. The treatment of nursery stock to destroy the eggs.
2. The control of the insect under orchard conditions.



THE APPLE SUCKER

(PSYLLIA MALI SCHMIDBERGER)

PLATE A

1, Twig showing condition of buds at time of hatching; 2, eggs on a small section of apple twig; 3, single egg (x33); 4, 5, 6 & 7, represent the first four stages of the nymph or immature insect (x33); 8, the fifth stage (x20); 9, adult female, summer coloration (x12); 10, the same, autumn coloration; 11, blossom cluster infested with nymphs and showing honey dew and wax secreted by insect; 12, greatly enlarged portion of young shoot, showing nymphs and one adult in place.

THE TREATMENT OF NURSERY STOCK. The necessity of finding some suitable treatment to be given imported nursery stock known to be infested or suspected of being infested with the eggs of these pests, is one that occurs immediately to any official entomologist.

Fumigation with hydrocyanic acid gas carried on in exactly the same way as for the San Jose Scale, with exposures varying from 1 hour to 10 hours, have been conducted for the past two seasons. Those during the past season, though on a much larger scale then the previous one, are far less satisfactory, because not only a very large percentage of eggs failed to hatch on our check trees, but the hatching was also very irregular.

However, the final result of all our work is to show that while a single hour's exposure to hydrocyanic acid gas destroys a very large percentage, and in some cases all, of the eggs, some individuals have survived an exposure of nine hours to the same strength of gas. The indications are, however, that spring fumigation is more effective than fall fumigation. It may be said that other fumigants such as carbon tetrachloride, even at prolonged exposures, failed to give satisfactory results.

Dipping the stock in various solutions was also attempted. In some cases we secured perfect results with certain of these mixtures, but in others under exactly the same conditions, a few individuals came through unharmed. As was the case with fumigation, the spring treatments were more effective than the autumn treatments, but the only material that gave perfect results spring and fall was 5% (by volume) emulsion of carbolineum. The liability of this compound to injure the buds, however, makes it doubtful whether it will ever find favor for this purpose, unless some one can devise a stable product of constant composition, and of equal value as an insecticide, which will, at the same time, be harmless to the trees. Furthermore, dipping as a means of treating imported stock has many disadvantages, as compared with gas treatments. Not only is it very laborious, unpleasant, and not adapted to large shipments, but it leaves too much to the individual carefulness of the operator. Even should some treatment be found that proved effective in careful hands, it is a question whether this method would be adopted by any government as a means of treating imported stock.

ORCHARD TREATMENTS. The control of the insect under orchard conditions may again be subdivided into (1) treatments directed against the egg or hatching young, (2) treatments directed against the nymph and (3) treatments directed against the adult.

1. For dormant spraying we have obtained best results, so far, by spraying with the lime and salt wash recommended by Theobald (Insect-Pests of Fruit, p. 162, 1909), consisting of 100 lbs. lime and 30

lbs. salt to each 100 gals. of water. This gave the best results when applied as late as possible before the eggs hatched. It is believed that the wash acts mainly as a mechanical barrier to the emergence of the young from the egg, but the salt probably exerts some direct effect also, since the omission of this ingredient lessens the effectiveness of the wash. In our experiments we usually made the application as soon as the buds showed the first sign of green at the tips. Later than this the leaf tips are likely to be more or less injured from the action of the salt.

It is only by the use of the greatest care and thoroughness in covering every smallest twig with the wash that successful results are secured and, in practice, we have found it necessary to make two applications to produce the desired effect. The fact that it is almost impossible to get on clay land so early in the spring with a heavy outfit is another disadvantage connected with this method. It is only one that a careful worker, situated on favorable land, can successfully employ.

2. This insect is one of the most susceptible to sprays in the nymphal stage of any we have had experience with, provided the sprays are applied when the insect can be reached by them. It is useless to attempt control while the leaves are unfolding or while the flower stalks are still fastened together. To do so invites failure, for the insects cannot be reached by the liquid or dust. When the flower stalks have separated out, a careful spraying of nicotine sulphate, ¾ of a pint to 100 gals. is most satisfactory. We have not as yet experimented with a reduced strength of this compound, but believe that, provided a proper pressure, etc. is maintained, a weaker strength would be equally effective.

We were also able to secure very satisfactory results from the use of nicotine dusts. To state the matter briefly, a dust containing 2% or more of nicotine sulphate (40% nicotine) with sulphur as a base gave only slightly poorer results than nicotine sulphate used as a liquid. The addition of lime to this mixture increases its effectiveness, but such mixtures gradually lose their strength and must be kept in air-tight containers. Clay used as a filler in place of sulphur gives a very inferior product, from an insecticidal standpoint.

3. The long preoviposition period of this insect seems to offer, indeed to invite, attempts at control in this stage. We were surprised to find, upon making the attempt, that the different sprays and dusts employed against the nymphs could be used with equally telling effect against the adult.

In addition to spraying and dusting we also made several trials of open air fumigation, after the manner reported to have given good results in Russia.

Our experiments indicate that 360 lbs. to the acre of waste tobacco, free from incombustible material, will give good control under favorable

conditions. It is unnecessary to use hay as a starter for the fires, as they burn quite well without such assistance. We have used damp vegetation to prevent the material from blazing up, but it seems likely that watering with a sprinkling can would have the same effect and would shorten the work. The fires can be ignited most rapidly by the use of a torch.

Numerous small fires are better than a few large ones. Where the latter are used on a still day, the smoke has a tendency to ascend directly upwards and be lost. It is of advantage also to have a number of heaps held unlighted in reserve, so that in the event of a wind suddenly arising or changing its original direction, these reserve heaps may be transferred to the windward side of the orchard.

The fall of rain during the process is not particularly to be feared, since our experiments show that once started, the fires keep on burning, even through a heavy shower. It is not advisable, however, to leave heaps out long unlighted in the rain, as this will result in the extraction of a large part of the nicotine. The fires will have to be drawn together several times, as there is a tendency for a part of the outside of the heap to remain unconsumed. In fact, it is advisable to pick up the smaller fires by means of a fork and to add them to those burning more vigorously.

It must be borne in mind, however, that success could only be hoped for in isolated orchards, or in cases where the operations covered a very large area. Furthermore, to further lessen the amount of reinfestation, it would be advisable to defer treatment as late as possible before oviposition, viz., at the end of August. All our experiments, though successful in controlling the insect at the time were quickly reinfested from without. Only by cooperative efforts over a very large territory could one even look for good results from this method.

Mr. W. E. Britton. I would like to ask if dusting with nicotine was tried?

Mr. W. H. Brittain. It was, and we found that if done at the right time, it was very effective. That is not mentioning the cost at all. It is a very easy insect to kill, either by dusting or spraying and either in the adult or nymphal stages may be used.

President George A. Dean. The next paper is "Spray Schedule for Red Bugs in Pennsylvania," by S. W. Frost.

THE FALSE APPLE RED-BUG (*LYGIDEA MENDAX*) IN PENNSYLVANIA

By S. W. Frost, *State College, Pa.*

The apple red-bugs are destructive insects in all apple sections of Pennsylvania. In spite of thorough spraying many orchardists have reported a failure to reduce appreciably the amount of injury by these pests. In view of this situation a study of the seasonal activities of the red-bugs was made with the result that the eggs were found to hatch somewhat earlier in most years than was generally supposed. Our records for a five year period confirm the earlier observations and it is now obvious that the pink spray comes too early to control the false red-bug.

The apple red-bugs were first noted as pests in Pennsylvania in 1912 when they were numerous enough to attract attention by the orchardists. Since that time they have increased rapidly in numbers and damage due to their work has been reported from all sections of Pennsylvania where apples are grown. During 1918 the damage in some orchards of Pennsylvania was as much as 80 percent. In 1919 there were few orchards in which susceptible varieties of apples were grown that did not suffer a greater or less amount of injury. The season of 1920, however, was notable for an overwhelming outbreak of the pests in Pennsylvania. During 1921, likewise, the amount of injury ran high in some orchards.

Since the publication of Professor C. R. Crosby's bulletin on the Red-bug, there has been no extensive work published on these insects to guide the fruit growers in their attempts to control the pest. The discovery in recent years in Pennsylvania, as well as other Eastern states, of certain facts regarding the life history and activities of these insects lend valuable suggestions for better control practices and noticeably hange the original recommendations.

Species Causing Injury to Apple

As in other Eastern states, two species of Red-bugs have been found in Pennsylvania attacking the apple; the true red-bug, *Heterocordylus malinus* Reut., and the false red-bug, *Lygidea mendax* Reut. The former species is not abundant in Pennsylvania and is not as injurious as the false red-bug. *Heterocordylus malinus* Reut., therefore cannot be considered at present as an injurious pest of apple in our state. Until the true red-bug is found more abundant, the timing of the spray applications should be made according to the habits of the false red-bug, *Lygidea mandax* Reut.

SEASONAL ACTIVITIES OF THE FALSE RED-BUG

The nymphs hatch shortly after the time that the color is showing in the cluster buds. From records taken during the years 1917 to 1921, it appears that in Pennsylvania the hatching of the red-bug eggs occurs after the pink condition of the buds. No nymphs were observed during these years before the blossom pink. During the unusually early spring of 1921, the relation of the hatching of the nymphs and the development of the buds remained the same and the eggs did not hatch until a considerable time after the pink condition of the flower buds.

The investigations of five consecutive years have been summarized on the following chart. During this period there were four normal years. In 1921 conditions as regards the bud development were extremely early. The data secured during this abnormal year add con-

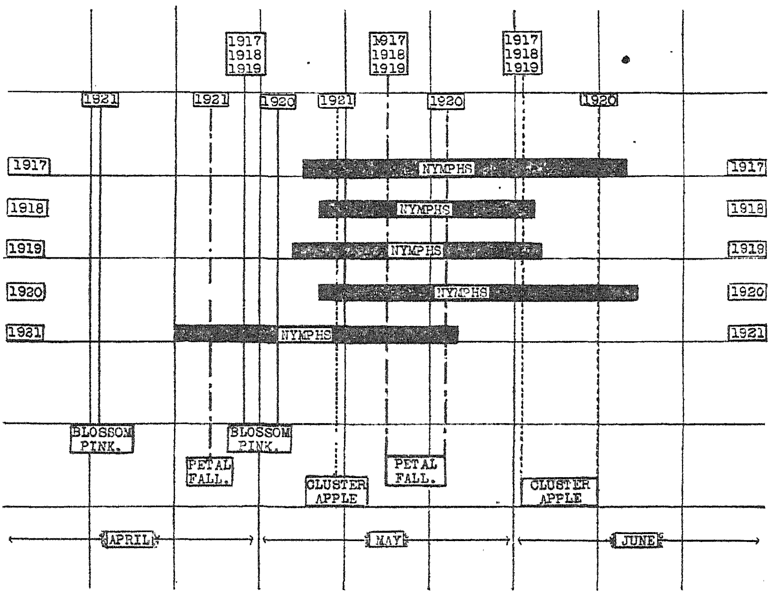


Fig. 2 Apple red-bug, *Lygidea mendax* Reut.; chart showing length of nymphal stage during five successive years.

siderably to the value of the chart as it shows very clearly that the same relation of bud development and insect activities exists even under extreme conditions. The horizontal broad, black lines indicate the length of the nymphal stage of the false red-bugs from the hatching of the first nymphs to the transformation of the first adults. The activities of the nymphs would therefore extend over a longer period than indicated by a single line for any particular year. The nymphal periods are based entirely on field conditions in a number of orchards. No

rearing work was done, but a careful search was made each spring for the earliest appearance of the nymphs. A large number of them were collected from time to time throughout the spring and summer and brought into the laboratory for the determination of the species and the several instars. The vertical lines for the blossom pink, petal fall and cluster apple applications were secured from actual spraying dates from six to ten orchards during these years. During 1917, 1918 and 1919 the dates for the applications were practically the same and represent normal years. In 1920 the various sprays were applied somewhat later than during the preceding years while in 1921 the season was much advanced and the sprays were applied from three to four weeks earlier than usual.

The data on the chart has further been corroborated by spraying experiments conducted in various orchards throughout the state. During the spring of 1920 a number of tests were made in various apple growing counties to ascertain if spraying in the petal fall and the cluster apple periods would reduce the damages from red bugs. These sprayings gave uniformly good control and the resulting injuries were small.

Timing of Operations

Two sprays are necessary to secure the most satisfactory control of red-bugs. The apple growers should watch for the first indications of foliage spotting by the nymphs and when this becomes noticeable preparations should be made to combat the pest in the following two sprays. In ordinary seasons these will be the Petal fall spray, when two thirds the petals have fallen and the Cluster apple spray which is two weeks later or when the young apples are the size of hazelnuts.

Adjournment.

Common Names of Insects:—The Committee on Nomenclature of this Association has prepared a list of about 1,000 insects, giving both common and scientific names. More than 300 common names have already been adopted by this Association, and the other 700 are now under consideration by the Committee. This list or a portion of it will be submitted to certain entomologists experienced in editorial work, former members of the Committee and specialists in the different orders. The whole list or any part of it will also be sent to any member on request who will carefully examine it and make suggestions looking toward a greater stability in common names of insects. The Chairman of the Committee on Nomenclature is Doctor Edith M. Patch, Agricultural Experiment Station, Orono, Maine.

REPORT OF MEETING OF COTTON STATES ENTOMOLOGISTS

Dallas, Texas, Nov. 30—Dec. 2, 1921

The meeting was called for the purpose of discussing the present status of the Camphor Scale, Mexican Bean Beetle, Pink Bollworm, Sweet Potato Weevil and Argentine Ant. The following representatives were in attendance at the various meetings: Drs. W. D. Hunter, C. L. Marlatt, Karl F. Kellerman and Geo. B. Sudworth of the Federal Horticultural Board, Messrs, E. R. Barber, F. C. Bishopp, J. E. Graf, W. E. Laake, Oscar Pool, K. H. Townsend and R. W. Wells of the Bureau of Entomology, Dr. W. E. Hinds, State Entomologist, Ala., Dwight Isely, Ark. Experiment Station, Geo. G. Becker, Ark. Plant Board, W. E. Anderson, La. Department of Agriculture, T. H. Jones, La. Experiment Station, H. H. Kimball, Miss. Plant Board, C. E. Sanborn, State Entomologist, Okla., G. M. Bentley, State Entomologist, Tenn., R. E. MacDonald, E. E. Scholl, J. M. Del Curto, J. M. Worsham, and J. S. Woodard of Texas Department of Agriculture, Dr. M. C. Tanquary, S. W. Bilsing and J. S. Reinhart of Texas A. & M., W. B. Lanham and R. R. Reppert Division of Extension, Texas A. & M., Hon. Harry Wilson, La. Commissioner of Agriculture, Hon. W. Perkins, La. Pink Bollworm Com., Hon. Geo B. Terrell, Commissioner of Agriculture of Texas.

Methods for Studying Insects Affecting Live Stock

The party spent a very interesting morning in the Dallas laboratory of the U. S. Bureau of Entomology, where Mr. Bishopp and his associates explained the various projects under investigation. There were general discussions on laboratory and office record systems, on photographic methods, and on systems for filing and recording alcoholic material in which the Bureau methods were thoroughly discussed and demonstrated. Various fly traps were studied and their merits and demerits pointed out. Mr. Bishopp gave us an interesting talk on the use of traps under range conditions and also explained the reaction of various species of flies toward various baits. Dried egg, according to Mr. Bishopp, is the best all-around bait for a number of species of flies which are of economic importance to the stockman. It is suggested that the southern entomologist may get some information of great value to them if they will write to Mr. Bishopp for information on the use of this bait.

The formal session of the Cotton States Entomologists was opened at 3 P.M. at the Jefferson Hotel. Dr Hinds presided. The first paper on the program was on the Camphor Scale, by Mr. E. R. Barber of the Bureau.

The Camphor Scale Situation

Mr. Barber pointed out that we knew practically nothing about the camphor scale. The pest is known to occur in Japan on citrus stock but it seems to be of little economic importance there. Outside of Japan the pest is not known to occur at any place other than New Orleans. This insect is supposed to have been introduced by N. Cook & Son, rose specialists of New Orleans, in a large shipment of roses from Alhambra, California.

The rapid spread of the pest has been very striking. It was discovered August 4, 1920 by Mr. Barber on some camphor trees in front of his home, not far from the Cook nursery; the scale was found on every species of plant around the place. The following spring the scale had spread to 27 blocks, with the original infestation as a center. Later there was a severe storm and it was found that scales were blown to a point two miles away from the original infestation.

In June 1921 the city of New Orleans appropriated $5,000 for eradication. This was later increased through various means to $15,000 and later the state made an appropriation for eradication. The first step consisted in making a survey to ascertain the amoun t of infested territory, which was about four square miles. There were about seven or eight nurseries in this territory and to these nurseries 148 isolated infestations in the rest of the city were definitely traced. A later survey turned up 200 more infestations. All told 450 isolated infestations were found outside of the original infested area and these were cleaned up. The isolated infestations discovered in the first survey were traced without exception to nurseries in the infested area. All of the balance occurred along paved and much traveled streets which passed through the infested area. It appeared that the latter infestations were spread maliciously.

A long series of experiments were carried on to determine a satisfactory spray.

Lime sulphur, miscible oils and numerous other preparations were tried without success. Finally a 2% emulsion consisting of fish oil potash soap and Junior Red Engine Oil (a Standard Oil Product) was found to give 100% control. All of the trees in the infested area were defoliated by pruning out all branches and limbs which had leaves on them and the trees were then throroughly sprayed. As an indication of the efficiency of the treatment, in 89 examinations out of 100, made 30 days after spraying no live scales were found. Three of the four square miles to be treated have been covered. It is planned to spray twice a year.

Mr. Barber now has two men who are turning out 1000 gallons of concentrated emulsion a day. The following formula is used: Potash fish oil soap, two pounds; Junior Red Engine Oil, two gallons; water, one gallon. The soap water is brought to boil with live steam, oil is added and the mixture boiled for five minutes. It has to be pumped twice before a satisfactory emulsion can be obtained. The concentrate costs 25c a gallon, which makes it cost 1c a gallon of solution ready to spray.

In marked contrast to the resistance of this scale to various spray materials is its susceptibility to cyanide gas. The gas from one ounce of NaCN to 1000 cubic feet kills all scales. The fumigating was done at a temperature of 85—92 degrees Fahrenheit. It was found that plants with flowers and leaves on could be exposed to this dosage for one hour without being damaged provided that they were put in the shade after the treatment.

Very little is known concerning the biology of the pest. The scales settle within a few hours after they are hatched. The males are always on the leaves and the females on the twigs. The females deposit from 200—250 eggs over a period of about one month. The unusually large scale of the overwintering female as compared with the summer form is interesting. It is considerably larger than is necessary to cover the body of the insect. Ants have been noticed in considerable numbers around infested trees and are doubtless factors in the infestation. So far about 8 species of parasites and predators have been found to prey on the species but it is doubtful if they cause 2% mortality. The insect is not known to be a carrier of disease.

The extremely toxic effect of this scale on most of our plants is of greatest importance. Only a few scales on a twig will cause defoliation. Trees have been known to be killed six months after they were attacked. Camphor, fig, rose, hackberry, elm, citrus and many other hosts are extremely susceptible to attack. The list of known hosts covers 172 species of plants. It seems certain that its noxiousness is by no means confined to tropical and semi-tropical plants and it must certainly be regarded as a potential pest of the first magnitude, for latitudes north of New Orleans until it can be definitely established that the climatic conditions there are such that the scale cannot thrive.

The quarantine work in connection with this insect was discussed by Mr. Barber and Mr. Anderson. The quarantine includes all territory within a radius of 20 miles around New Orleans and has been effective since June 1921. No certificates are granted to any nursery located in this territory. All nursery stock from this territory must be inspected by a state inspector and must be fumigated by him. No nursery stock whatsoever is allowed to move out of the infested territory and nurseries located in this area are now out of business. Every nursery in the quarantine area is inspected once every thirty days. There is thus a quadruple protection in the fact (1) that all nurseries in the infested area are out of business. (2) No blanket certificates are granted to any nurseryman within a radius of 20 miles of the infestation, (3) all stock in the quarantine area and not in the infested area is first inspected by a state inspector and is then (4) fumigated by this inspector. All post office clerks and agents of common carriers are well informed on the regulations.

Mr. Anderson stated that they were now at work tracing shipments of plant products which went out of the infested area before the infestation had been discovered but that the work was progressing slowly on account of the lack of funds. He suggested that other states might be able to render help in some sort of a cooperative capacity for hastening this work. Three infestations in Mississippi have been traced to New Orleans but they have been stamped out.

It was generally agreed that "Camphor Scale" was not a very appropriate name for this pest in that the insect attacked a large number of hosts among them being all species of fruit trees, as well as oak, hickory, hackberry, elm and numerous other hosts. Those having a more appropriate name to suggest should communicate with the committee on Nomenclature of the American Association of Economic Entomologists.

THE MEXICAN BEAN BEETLE (*Night Session*)

At this session Dr. Hinds gave an illustrated talk with a most unusual set of slides showing the Mexican bean beetle in all of its stages and Mr. Graf discussed the spread of the pest, work with insecticides, and the result of effort to find natural enemies.

Many of the illustrations appear in Dr. Hinds' bulletin on the Mexican Bean Beetle and in the same bulletin is a thorough discussion of the life-history and habits of this pest. In Alabama there were four generations of the insect in 1920. In 1921, although there was ample time for the development of a 5th generation, it did not appear. In 1921 Dr. Wickham left Alabama when the infestation was at its crest and when he arrived at the high elevations in Mexico to collect parasites he found that this pest had practically disappeared for the season. In New Mexico the insect has but two generations a year. It is thought that the cool nights might possibly cause a chemical change in the leaves which may cause breeding to stop.

The discussions of Dr. Hinds and Mr. Graf showed that the pest was evidently not at all settled to eastern conditions. In 1920 it migrated at the end of the season whereas in 1921 most of its migrating was done in early summer.

Dr. Hinds pointed out that an important fact in considering the possibility of spreading this pest in shipments of nursery stock is the fact that a female fertilized in the fall may winter successfully and deposit fertile eggs the following spring. New infestations may thus be established by transporting a single hibernating female to a new locality.

It now seems certain that the insect was introduced into Alabama in shipments of alfalfa hay from Utah. Dr. Ball states that before the war the bean-growing area in Utah was isolated from the alfalfa growing regions but during the war it became profitable to grow beans in the alfalfa regions and for the first time the beetle had an opportunity to be carried out of the state in alfalfa hay. It was at this time that it was carried to Alabama.

In regard to host plants, mung beans and velvet beans seem to be rather resistant to this insect. Beggar weed seems to be a favorite host. Cowpeas seem not to be attacked ordinarily until they are 20—30 inches high, according to Mr. Graf.

Dr. Hinds has reared the insect through all its stages on alfalfa and velvet beans. It will feed on non-leguminous plants when it is starved to it. The insect is primarily a leaf feeder though it will feed on the pods when the leaves are gone. In order of their susceptibility to the Mexican bean beetle Dr. Hinds places the legumes as follows: (1) kidney beans, snap beans and corn-field beans, (2) lima beans, (3) cowpeas and (4) soy beans.

The destructiveness of the pest is well known to all southern entomologists who have followed the history of the pest. Dr. Hinds states that in 1919 a farmer near Birmingham made $400 on an acre of late beans. The following year he planted two acres the first week of August, had to plow them under the first week of September, and did not get enough beans to can for home use. This case is quite typical. The insect will cause a 75% loss to the bean and pea crop of the territory infested.

According to Mr. Graf control of the insect by the use of arsenicals is very difficult. The stable arsenates are not effective. They seem to pass through the digestive tract of the insect before they can be acted upon. On the other hand the insecticides which are effective against the insect are very injurious to the tender foliage of legumes. In hot dry weather effective insecticides can be used without injury but if the weather is humid, injury will result. The most stable forms of calcium and lead arsenate will strip the vines. If this pest is to be controlled by the use of insecticides, a new one will have to be used.

Control by the use of natural parasites is equally unpromising. After seven weeks in Mexico, Prof. Wickham found only one parasite, a Tachinid parasite which attacks the adult beetle. This was found quite by accident.

The present range of the insect in the South includes 36 counties in Georgia, 34 counties in Alabama, 34 counties in Tennessee, and 2 counties each in Kentucky, North Carolina and South Carolina.

SWEET POTATO WEEVIL ERADICATION (*Morning Session, December 1*)

This subject was discussed by Mr. J. E. Graf. It was pointed out that the sluggishness of this insect made it an easy subject for eradication. The matter of eradication is not a technical one but is rather a problem of thorough extension work with a view to getting farmers of the infested area to co-operate. Where one can control the planting seed and slips which are used in the infested area and can combine this with clean culture, the problem of eradication has been solved.

The method used in Mississippi and Florida of supplying slips has given some trouble. The farmers in the infested area depend upon sweet potatoes for much of their food and when bedding time comes they are afraid to wait for slips which the plant board promises to send them later. For this reason many out-law slip beds are planted.

In one case nine reinfestations were traced to an out-law slip bed. Instead of supplying slips as in the past, the farmers will be supplied their sweet potatoes and will be allowed to bed them down for their own supply of slips.

The eradication work has involved, all told, about 900 farms. In Florida only 30 infested premises remain out of 300. In Alabama eradication is complete in practically all areas where potatoes are grown commercially. The largest amount of eradication work is still ahead. In Texas the weevil occurs more or less generally in all that territory east of a line drawn due north of San Antonio and extending to the Red River. It might be of interest to state here that Mr. Sanborn said that he had recently found the weevil at Antlers, Oklahoma and Mr. Jones stated that it had reappeared at Shreveport, Louisiana.

One of the difficulties of eradication work was to complete it after the weevil had become almost exterminated in an area. When weevils have been reduced to the extent that they no longer cause any damage farmers lose interest in the work. Thus it is practically necessary to visit infested farms at least once a week. The inspector virtually supervises the growing of seed potatoes for the entire season. Extension work should be more vigorously pushed in connection with eradication and farmers should be thoroughly impressed with the destructiveness of the pest.

There are two times of the year to scout for the weevil. One is in the fall at harvest time, the other in the spring when the potatoes are to be bedded. In the fall the pest is detected by tearing the vines apart; in the spring in the potatoes. During the time that potatoes are in curing, development of the weevil is doubtless accelerated. Wild morning glories are known to harbor the pest. In general any large rooted morning glory will make a good host. Of greater importance than the abundance of wild hosts is climate. But for this Mr. Graf thinks that the pest would be destructive in California.

In regard to the size of a safety zone around an infestation, five miles is considered ample. The biggest factor is preventing the weevil from being carried from one place to another in seed. The ordinary "visiting distance" is not more than about five miles for the average farmer. Inspection of potatoes for the weevil at harvest time is considered worthless.

Eradication of the Argentine Ant

Mr. Barber discussed the life-history and habits, economic importance, methods of control, including the making of the poisoned bait and application of same. The control of this pest is fraught with many technicalities. Eradication work should be carried on under the immediate supervision of an entomologist and the entomologist will do well to get instructions from Mr. Barber.

The economic significance of the Argentine Ant is so overwhelming and the control measures have been so thoroughly worked out that entomologists should find eradication work to be an unusually profitable project. Fortunately it can be accomplished at a small cost and the funds can, in most instances, be raised locally. A few carefully conducted eradication problems will do much to popularize entomological work.

The Argentine Ant causes at present an annual loss of not less than $25,000,000. It has been conservatively estimated that this is only about 1% of what it is capable of doing. In orange groves and sugar plantations its injury comes indirectly. Its presence in orange groves is noticed by a large increase in infestations of all kinds of scale insects which under normal conditions are not an economic factor. In sugar plantations mealy bugs become unusually injurious. In cities shade trees are killed by scale insects which are hardly noticed before the appearance of the ants. In the citrus growing area which is infested by the ant, groves have been planted over and over again only to be killed out by scale insects which become abundant because their natural enemies are being kept away by the ants. In addition to these losses there are heavy losses to food products in storage. It is almost impossible to raise chickens or keep bees in infested areas.

Eradication is now being carried out in New Orleans and Baton Rouge on a large scale. About 150 cans of poison are being used to a city block. The complete cost for one treatment is about $12.00 a block. Funds for this amount can usually be secured without any difficulty. Eradication can be done in the fall or in the spring but the best time is from about August 15 to October 15. After the first year the

work should be followed up for two or three years following, using about ¼ the number of cans used in the first campaign. Complete eradication is considered entirely possible. The best can used for the syrup is the stock shrimp can holding about 6 ozs. They are bought with special lids.

In scouting for the Argentine ant first look around in the wholesale districts where freight is being loaded and unloaded. Then look at trees. Trees in infested areas can usually be seen 16 to 18 feet away by one who has a trained eye. They are usually badly infested with scale insects and the characteristic movements of the ants can be observed. Mr. Bishopp says that the Argentine ant has a characteristic odor and this was confirmed by Mr. Kimball. When the edge of the infested area has been found it is an easy matter to trace out the area.

Fully one-half of successful eradication depends upon the preparation of the syrup. An ordinary druggist cannot be depended upon and even a chemist is likely to be careless. Syrup is being made for New Orleans, Baton Rouge and other southern cities under Mr. Barber's supervision and can probably be purchased for about 65c a gallon. A number of firms have been making ant syrup, charging as high as $3.00 a gallon for it, but their products are not dependable.

Campaigns have often been discourged by local druggists and others who have been making money in the sale of proprietary compounds and they have disseminated propaganda stating that children have been poisoned by the syrup. In conducting eradication campaigns this sort of propaganda should be headed off and the methods of eradication discussed carefully in advance.

Cotton Seed Sterilization (*Afternoon Session*)

Cotton seed sterilization, according to Mr. R. E. MacDonald, should be put into practice by every southern state as an added precaution against the spread of the pink bollworm. It is believed that sterilization can be developed to the point where practically 100% of the worms can be killed; 98% of the worms are being killed with seed temperature at 130° F.

Mr. MacDonald's figures were based on investigations which he had conducted and on investigations which were conducted by the Bureau. It was found that seed could be heated to a temperature of 170°F. and held at that temperature for an hour without hurting the seed. Moreover the heat treatment apparently improved the germinating quality of the seed. Egyptian workers consider that 162° F. is a safe temperature for seed.

It was found that the thermal death point of Pectinophora larvae was between 130 and 145° F.

130°	F.	for	45	min.	killed	100%
130°	F.	for	30	min.	killed	62.5%
135°	F.	for	35	min.	killed	100%
140°	F.	for	20	min.	killed	100%
145°	F.	for	10	min.	killed	100%

The above temperatures are the temperatures which the seed mass actually reached. To attain these temperatures it was of course necessary to have the oven much hotter as heat penetrates the seed mass very slowly. This was thoroughly demonstrated by MacDonald in a number of experiments. It was found that with the temperature of the oven at 239°F. it took five minutes to raise the temper ature of the seed mass, two inches deep, from 73° F. to 82° F. With the oven at 275° F. it requred 45 minutes to raise the temperature of the seed mass at four inches deep from 73° F. to 140° F.

To heat effectively a machine must be devised which will keep the seed stirred up so that the seeds will be isolated one from the other and which will heat the seed to the required temperature in not more than about five minutes. A sterilization apparatus requiring longer than this would not be practicable. The sterilizer must be carried as a continuous process of ginning. In the sterilizers which it is planned to put in effect in Texas the seed will be heated to much higher temperatures than is done in Egypt. The seed mass when it leaves the machine should be about 140° F. In addition to the high oven temperature the seed will be subject to a continuous and somewhat protracted high temperature on account of massing and retaining the heat after it leaves the oven because of the numerous air spaces between the fibers.

Several types of machines have been devised in Texas. One type consists of a series of belts upon which the seeds are spread out one layer thick and carried through the oven several times. Belt number one carries the seeds the full length of the oven and drops them on belt number two and so on. Another type consists of a sheet iron revolving drum about three feet in diameter and ten or more feet long, the flanges on the inner circumference, which carry the seed to the top and drop them down continually over a number of radiating steam pipes which revolve with the drum. A third type is now in process of manufacture by the Ryland Company of Austin. It consists of a series of cut flight conveyors operating inside an insulated steam oven. The upper conveyor carries the seeds the full length of the oven and delivers them to the next conveyor which in turn carries them to the next conveyor and so on.

The different types of machines will be taken to Mexico, tried thoroughly and if successful, attempts will be made to ultimately require all cotton gins to be equipped with sterilizers.

Pink Bollworm Scouting

Mr. K. H. Townsend gave a report on the progress of pink bollworm scouting conducted by the Federal Horticultural Board under his supervision. His work is summarized in a report which may be had on application to the Houston office. In the same report is a record of the tracings of all Carlsbad seed. Another report, "Summary of the Pink bollworm Situation" released by the Federal Board of Horticulture under date of November 26 should also be in the hands of all southern entomologists.

Scouting work is begun each year at the southern end of the cotton belt and the scouts moved northward as the season advances. Whenever an infestation is found, tracing is done at once by the central office and new scouting points are included in the itinerary. Scouting is begun at Brownsville about June 15.

On October 6 scouting was begun at Ennis and after only about two weeks an infestation was found about three miles south of Ennis. Carlsbad seed has been planted south of Ennis as far as Kaufman County. During the three weeks following the infestation four more infested fields were found. Scouting was carried out in all directions from the infested centers but no more pink bollworm was found.

A few weeks later an infestation was found at Marilee. The infestation occurred on the Collins-Grayson county line and occurred in two fields. It arose from flights of moths which emerged from Carlsbad seed which had been stored in a gin house, as no infested seed has been planted.

About two-thirds of the places getting suspicious Carsbad seed have been scouted to date. Fifty scouts are now in the field. All ginning territory around Marilee is considered dangerous for another year. At Ennis the scouts put in at the rate of one man a day per 2/3 acre.

In the Carlsbad area (including four towns) infestations were found at each place. The infestation is regarded as being generally distributed over about 15,000 acres.

It is expected that scouting will be completed at all suspicious points which need it. There is still scouting to be done in Texas, Oklahoma and Louisiana.

Mr. MacDonald then discussed some observations made on his Mexican trip. Damage from the pink bollworm ran all the way from 5% to 75%. In some places the boll weevil and the pink bollworm caused a total loss. In one field at Torreon 90% damage was noted.

General Discussion on Cotton Dusting

Mr. MacDonald made the statement that where cotton had been dusted for the boll weevil he found the bollworm (*Chloridea obsoleta*) to be much more severe than where dusting had not been carried out. Plant lice were also much more severe. He attributed the presence of large numbers of plant lice to the fact that predators had been poisoned.

Mr. Bishopp verified these findings. He attributed the increase in bollworms to the fact that predators which ate the eggs of this species had been killed. Mr. Reinhart also verified the statement made with reference to the abundance of plant lice, and stated that it was at a time when it was hot and dry and when heavy plant lice infestations were not to be expected. It was noted that hymenopterous parasites were still at work, however, though there was a marked decrease in the number of Coccinellids.

Mr. Reinhart's experience led him to the conclusion that it did not pay to dust this year. In one case his dusted plots yielded no more than the check and in another instance there was a 30% increase as a result of dusting. He had to put on 8 or 9 applications to put down the infestation.

Dr. Hinds thinks it pays to dust early in the fruiting season and when the weather is rainy. In hot dry weather it will not pay. Four or five applications under the proper conditions will be profitable. As far as failure of dusting to control bollworms is concerned Mr. Bishopp thinks that applications have not been made on time. This should be done within two or three days after hatching of the bollworms begin. After that time the worms can not be reached. Theoretically this period is about the time when the field corn begins to harden.

Moving Pictures on Insects Affecting Live Stock (*Night Session.*)

Mr. Bishopp gave us four interesting and highly entertaining reels illustrating Stable Flies, Horn Flies, Screw Worms and Ox Warbles.

Each reel showed characteristic habits and poses of the species of flies, which were illustrated, the mouth parts, stages of the insects, how they affected stock and methods of control of each species. Model traps were shown and methods of operation for each species were illustrated. Proper stacking of straw to prevent breeding of stable flies was shown. The treatment of screw worm infested sores and the destruction of carcasses was illustrated in connection with this pest. By far the most interesting reel was the one illustrating the Ox Warble. Every southern entomologist who has occasion to do extension or teaching work should make an effort to borrow this reel from the Bureau. The subject is handled in a very entertaining and most popular as well as a very forceful way. Incidentally ox warble eradication offers a most fruitful field for the entomologist's consideration.

Extension Entomology (*Morning Session, Dec. 2*)

An informal discussion was carried on for about an hour before the pink bollworm hearing, during which extension entomology was discussed. The feature of the discussion was a plan submitted by Mr. Anderson in which he proposed to divide the state of Louisiana into eight or nine districts. In each district there was to be a competent entomologist who was to conduct not only inspection and quarantine work but also extension work. He was to inspect all nursery stock and other plant products of his district and was to be in complete charge of all regulatory work. In addition to this he was to give expert advice and help to the county agents in his district. This work was to be divided into four seasons. In the winter the work would consist largely of inspecting nursery stock and of making plans for spring and summer. In the spring and summer demonstration spraying would take up much time as well as regulatory work along this line During this same period there would be sweet potato weevil eradication and in due time Argentine ant eradication.

It was generally agreed by all those present that there was a very fertile field along the lines suggested by Mr. Anderson.

Mr. Reppert was of the opinion that an extension entomologist could not afford to jeopardize his work with the regulatory work as in all regulatory work much hostility is engendered. It is also doubtful if men working under Government funds could be allowed to do regulatory work. Under the conditions which obtain in Louisiana, however, the plan is workable.

The balance of the day was spent in connection with the pink bollworm hearing. Most entomologists have by this time received the resolutions passed at that hearing and it is thought that these resolutions will form the basis for the future policy of the Federal Board of Horticulture in the eradication work.

George G. Becker, *Secretary*

RESOLUTIONS

Passed by the Cotton States Entomologists in session at Dallas, Texas, November 30 to December 2, 1921.

Whereas, the cost of eradicating the pink bollworm is insignificant in comparison with the economic consequences to the whole United States as a result of the permanent establishment of the pink bollworm in the South, and

Whereas, the eradication work of the Federal Horticultural Board cooperating with the States of Louisiana and Texas through the maintenance of non-cotton and regulated zones has, in our judgement, showed that this pest can be eradicated, and

WHEREAS, there is necessity for further immediate investigation of the possible occurrence of the pink bollworm at several suspected points in the cotton belt, and

WHEREAS, it is our belief that sterilization of cotton seed, regardless of where grown, would be an important protection in preventing the spread of the pink bollworm;

Be it therefore resolved, that we urge upon Congress and upon the legislature of the different southern states the appropriation of ample funds to assure prompt investigation of all suspicious reports of the presence of the pink bollworm and of providing, without delay, for the immediate creation of non-cotton and regulated cotton zones where necessary.

Be it further resolved that the eradication of the pink bollworm through the maintenance of non-cotton and regulated zones be not only continued as at present but extended without delay wherever the result of scouting work shows this to be necessary.

Be it further resolved that thorough pink bollworm scouting covering all possible points of infestation should be completed in time this year to include additional areas in the non-cotton and regulated zones next season for all additional areas where the pink bollworm is found.

Be it further resolved that we urge the adoption of compulsory cotton seed sterilization to the end of reducing the danger of the possible spread of this pest.

M. C. TANQUARY
GEO. G. BECKER
H. H. KIMBALL
Committee on Resolutions

Scientific Notes

Notes on Stictocephala festina. In the detailed account given of this pest as published in the *Journal of Agricultural Research* Vol. iii, No. 4, it is pointed out that the insects had not been found above 3868 feet. During the summer just past the insects were found quite abundant near Prescott, Arizona, at elevations of 5400 feet.

In the account above cited injured alfalfa plants are spoken of as yellowish in appearance. In the Verde Valley and vicinity, Arizona, affected plants generally have a bluish or purplish color. In the late summer or early fall fields are common with scarcely a shoot free from this discoloration. I have found a rather large percent of the girdles or cankers infected by a species of *Colletotrichum*, apparently near *destructivum* O'Gara.

WYATT W. JONES
Salt Lake City, Utah

Successful Poisoning of Eleodes Beetles—False wireworms, larvae of *Eleodes hispilabris*[1], are a serious pest of dry land grain in Idaho, and are increasing in numbers at an alarming rate. Because no effective, practical control measures have been known, it has been impossible to give needed help to farmers. The possibility of poisoning the adults before they have mated and deposited eggs has appealed to the writer since he first began studying the problem. In August 1921 field observations were made as to the habits and food of newly emerged adults. Laboratory experiments were then conducted to determine whether beetles could be killed successfully by poison preparations. Following this, poisoning was undertaken on a small scale under field conditions and finally the operation was broadened to cover a forty acre field. Field observations lead to the belief that adults emerging in late July and early August do not mate and lay eggs until the following spring.

Essential data are: Adults feed greedily for at least a month after emergence, during which time no eggs are deposited. They are readily killed by poison bran

[1]Det. Joe S. Wade—United States Bureau of Entomology.

mash before they have had an opportunity to reproduce. They are active travelers and when coming to a depression or furrow are likely to follow along the bottom for a distance before climbing out. They eat poison bait readily even when there is an abundance of unpoisoned food.

Eleven days after bait was applied lightly in a furrow 390 yards in length, 7653 dead beetles were counted. A large number, in addition, had crawled away from the furrow before dying. Poison bait was apparently as effective at the end of 10 days as when first distributed. Thousands of beetles were killed by broadcasting poison mash on waste land and around straw stacks. The cost of material for treating 40 acres by the furrow method was 70 cents, less than 2 cents per acre—furrows spaced 100 yards apart. By a mechanical device, a furrow was treated as fast as a team could walk. It appears possible to very nearly eradicate *E. hispilabris* in a community by use of poison bran during two successive seasons, if cooperative work is done over a large area. During the present year, the University of Idaho will carry on further work on life history and large scale control of species of Eleodes injurious to grain.

CLAUDE WAKELAND
Entomologist, University of Idaho Extension Division

Some Ants noted to infest houses in Mississippi during the summer and fall of 1921. During the summer and fall of 1921, the writer had the opportunity of observing many species of house ants in Mississippi. This opportunity arose during the period when the writer was scouting for Argentine ants or assisting in the campaign against these ants in many of the towns in the State. It seems well to mention very briefly here the species observed and what has been noted concerning their distribution and habits.

Ten species have been noted as house pests. Six of these are imported ants, the others are native ants. In mentioning these ants below, the writer will rank them according to his idea of their economic importance as house pests in Mississippi.

By far the worst house ant in the State is the Argentine ant, *Iridomyrmex humilis* Mayr., which has been recorded from forty-one towns in this State and no doubt occurs in many others, of which we have no record. As a house pest this ant has the habit of crawling everywhere; getting into peoples' beds, driving setting hens from the nest, crawling over ice cold meat in refrigerators and acting as distributors of injurious scale insects on shade trees and fruit trees.

The next two species, one of which is an imported ant, hold about equal rank as house pests. *M. pharaonis* L. and *Monomorium minimum* Buckley, are practically the same size and have similar habits, being particularly fond of meats and greases. The former is known as the small red ant or Pharaoh's ant, and the latter as the tiny black ant. Both species are widely distributed throughout the United States and the writer believes they are widely distributed in Mississippi, as he has found them in practically every town visited.

Solenopsis geminata Fabr., commonly known as the fire ant because of its stinging habit, seems to be a common house pest also. Like the two species above, it prefers meaty foods, but will eat sweets when the opportunity permits. The writer has not observed any of these ants nesting in houses and he doubts very much if they do so, since they are soil nesting species. Their crater-like nests in the soil are generally found in sunny spots. No doubt they stray into houses because of the scarcity of food outside.

Another species of this genus—the tiny yellow thief ant, *Solenopsis molesta* Say, is a house pest also. It resembles *M. pharaonis* superficially, but it is much smaller

than that species and can easily be distinguished from *M. pharaonis* when examined under a microscope. It not only occurs in houses, but has been noted to attack the seed of cereals in Kansas.

The acrobatic ant *Cremastogaster lineolata* Say, has been found to occur in a number of houses. This ant is widely distributed over the State and has a fondness for sweets. This is no doubt the reason why it is attracted to houses. Out doors it may nest under stones, in wood, in galls, etc. Because of these varied nesting habits it is possible that *lineolata* may nest in houses, but it is the writer's opinion that this is seldom, if ever, the case.

Iridomyrmex analis Mayr, an ant closely related to the Argentine ant in general character and habits and often mistaken for this species, has been found to give trouble in houses. This seems to be exceptional rather than the rule. These ants are also fond of sweets like their near relative the Argentine ant. The two species can be readily distinguished from each other by the presence of a sweetish sickening odor given off by the workers of *analis* when crushed, while the workers of *humilis* have no perceptible odor. *I. analis* also has a much lighter colored abdomen than the Argentine ant, workers of the latter being of a uniform brownish coloration.

Tetramorium guineense Fabr. has been noticed to occur in one of the sea port towns of this State—Pascagoula. It is an imported species, having come from the Old World. In some towns in the United States it has assumed importance as a house infesting species. So far as the writer knows it has caused no trouble in Mississippi.

Another imported species, *Solenopsis geminata* Fabr. subsp. *rufa* Jerdon, has been recorded from Tupelo. This ant, which is also an Old World species is capable of becoming a house pest, although it has not been reported so from that town to date. A striking fact is that no other species seems to be present in the town where this ant occurs. It is quite possible that *S. geminata rufa* has driven out the native ants.

Camponotus caryae var. *rasilis*, a very striking red and black species that nests in trees, has been observed to infest one house this year. The workers showed a particular fondness for sweets, infesting jam, sugar and syrup.

M. R. Smith
Mississippi State Plant Board

Sulphur Investigations. It is most gratifying to state that the Crop Protection Institute has succeeded in securing the cooperation of three sulphur companies—The Union Sulphur Company, The Freeport Sulphur Company and The Texas Gulf Sulphur Company—in providing for basic studies of both the entomological and phytopathological aspects of sulphur, each in relation to meteorological conditions. These companies have agreed to provide $7500 a year in addition to raw materials for a period of two years, the project to be administered by the Crop Protection Institute. It is expected that two or three research men will be located in existing laboratories, probably state experiment stations, under conditions which will permit of a thorough investigation of all the important factors, beginning with elemental sulphur and from this proceeding to compounds of sulphur.

This is a gratifying start toward solving problems of vital importance. May it prove to be only the beginning of a series of studies directed toward developing more efficient insecticides and fungicides.

E. P. Felt

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1922

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, provided that at least 100 reprints be ordered at full price rates; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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The Circulation Agent, C. W. Collins, has been appointed and has started operations. There is only one way to make good with Mr. Collins, and that is turn subscriptions in his direction. He is endeavoring to secure the coöperation of all for our mutual benefit. Have you "registered?"

The Toronto meeting must be regarded as an unusual occasion. It was an anniversary of our organization meeting. It was unique in there being sessions of the three national entomological societies of America, namely, the Entomological Society of Ontario, the Entomological Society of America and our own organization. These meetings brought together an unusually representative body of men—there were over 100 in the group photograph reproduced in this issue. It was particularly gratifying that such pioneers as Bethune, Forbes, Comstock, Howard and Osborn could be present. This gathering is not likely to be duplicated or eclipsed for many years. It was especially gratifying that such a very high proportion of the Canadian entomologists were in attendance. The dinners to entomologists were not only pleasant but extremely desirable features. We need to cultivate that feeling of good fellowship and solidarity, if we are to do our best. The prevailing sentiment is well expressed in the proceedings, reproduced on another page, at the general dinner.

The attention of all contributors is called to the marked changes in reprint prices, the arrangement concerning the early publication of papers and the elimination of an arbitrary limit in length in case at least 100 reprints are ordered at full price rates. In interpreting the action of the Association at the Toronto meeting concerning the publication of papers for which the author or institution with which he is

connected was willing to pay in case a number of reprints were supplied, it became necessary to change the rates for reprints. Heretofore they have been furnished at cost of printing and the JOURNAL has frequently met financial loss and there has been considerable difficulty in handling the business in connection therewith. In order to avoid the misunderstanding and confusion likely to result from the establishment of two rates, it has been decided to adopt a flat rate, with a reduction to members. It will be noted that 50 folio reprints may be obtained at a very low rate, but that the prices for all others are higher than heretofore. It is believed that most of the members who desire reprints for wider circulation than the JOURNAL affords will have little difficulty in securing them through the institutions with which they are connected.

Current Notes

Professor Herbert Osborn is spending the winter in Mississippi.

Mr. W. K. Makemson has been appointed extension entomologist and plant pathologist at the Florida University and Station.

According to *Experiment Station Record*, Professor G. M. Bentley, Associate Entomologist, was on July 1 transferred entirely to instruction work.

The annual address of the Entomological Society of America was delivered at Toronto, December 28, by Dr. Seymour Hadwen on "Northern Oestridae."

Mr. O. C. McBride has been appointed assistant in entomology at the Missouri Agricultural Experiment Station, in place of S. R. McLane, resigned.

Professor William Morton Wheeler of the Bussey Insitution, Harvard University, was elected president of the American Society of Naturalists at the Toronto meeting.

Mr. James Godkin has recently been added to the staff of the North East Laboratory, Bureau of Plant Industry, Pennsylvania Department of Agriculture.

Mr. F. H. Worsinger, Jr., is now locally in charge of the Japanese beetle work, Bureau of Plant Industry, Pennsylvania Department of Agriculture.

Mr. V. I. Safro, formerly of the Kentucky Tobacco Product Company, Louisville, Ky., is now Vice-President of the Nicotine Production Corporation of Clarksville, Tenn.

Professor C. R. Crosby, Extension Entomologist of Cornell University, addressed the annual meeting of the Connecticut Pomological Society at Hartford, on December 14, 1921.

According to *Experiment Station Record*, Mr. W. E. Jackson was appointed on September 15, Assistant Professor of Entomology at the Oklahoma College, vice Otis Wade, resigned.

Dr. W. C. Cook, formerly of the Minnesota Agricultural Experiment Station is to be connected with the Montana Agricultural Experiment Station in charge of cut worm investigations.

Professor G. H. Lamson of the Connecticut Agricultural College, Storrs, Conn., gave an address on January 6, before the New Hampshire Poultry Association at Concord, N. H.

A new laboratory has recently been built at Chambersburg, Pa., for the Bureau of Plant Industry of the Pennsylvania Department of Agriculture, and occupied September 1, 1921.

Mr. T. T. Haack, formerly of the Wisconsin Department of Agriculture is now in charge of the North East Laboratory, Bureau of Plant Industry, Pennsylvania Department of Agriculture.

Professor H. A. Gossard, entomologist of the Ohio Agricultural Experiment Station, recently spent a week of his vacation in Florida, where he was formerly entomologist of the Station.

Professor S. Mokrzicki, formerly entomologist of the Taurida Zemstvo in Simferopol, Russia, and more recently State Entomologist in Bulgaria, has been appointed Professor in the Agricultural High School, Warsaw, Poland.

At the entomologists dinner held at Prince George Hotel, Toronto, December 30, 117 were present. The speakers were Dr. L. O. Howard, Professor J. H. Comstock, Professor Herbert Osborn and Professor Lawson Caesar.

Mr. James B. Palmer has been appointed instructor in Extension Entomology in the New York State College of Agriculture, to succeed M. D. Leonard, who has taken a position with the Bowker Insecticide Company.

Dr. W. S. Regan, Assistant Professor of Entomology, Massachusetts Agricultural College, has accepted a position in the Department of Entomology, Montana State College, where he will devote half his time to teaching and half to fruit insect investigations.

According to *Science* Dr. E. D. Ball has been appointed by Secretary Wallace as the representative of the U. S. Department of Agriculture on the research information service of the National Research Council, to take the place of Dr. Carl L. Alsberg, resigned.

Dr. L. O. Howard gave the address of the retiring president of the American Association for the Advancement of Science on Tuesday evening, December 27, at the Toronto meeting. His subject was (a) "On Some Presidential Addresses:" (b) "The War Against the Insects," and was printed in *Science* for December 30, 1921.

On account of the severe illness of Professor Robert Newstead, the cooperative investigations on mite-infested wheat, carried on by the Liverpool School of Tropical Medicine, the Grain Research Laboratory, Winnipeg, and Mr. E. H. Strickland of the Stored Pests Investigations of the Entomological Branch, Canadian Department of Agriculture, have been temporarily discontinued.

Dr. L. O. Howard gave the first lecture in a course of popular scientific lectures before the Royal Canadian Institute at Toronto, October 29, 1921. His subject was "Some Aspects of Economic Entomology." It is expected that the other lectures in this course will be given during the winter by scientific men from the United States.

Science is authority for the announcement that a movement has been started to raise a fund of $2,000,000.00 to establish a medical school as a memorial to Major General William C. Gorgas. The present plan is that the fund be contributed by the nation and that the school be situated in Tuscaloosa, Ala., where General Gorgas lived as a boy. Dr. Seale Harris of Birmingham, Ala., is Chairman of the National Committee.

The following transfers in the U. S. Bureau of Entomology have been announced: J. D. Waugh, Mexican bean beetle control to plant quarantine inspector, Federal Horticultural Board; F. R. White, Mexican bean beetle investigations to sweet potato weevil investigations, at Gulfport, Miss.; John B. Gill, in charge of laboratory, pecan insect investigations, Brownwood, Texas, to Aberdeen, N. C., to investigate plum curculio and other peach insects; A. I. Fabis will have charge of laboratory at Brownwood, Texas.

The following resignations have been reported from the U.S. Bureau of Entomology; A. D. Borden in charge of laboratory, Alhambra, Calif., to accept a position as entomologist and manager of a local insecticide company. The laboratory has been closed. George H. Rea, Extension Specialist in Apiculture for New York, to accept similar position with the Pennsylvania Department of Agriculture; E. S. Prevost, to accept a state appointment wherein he will continue teaching and extension work in apiculture at Clemson College, S. C.

According to *Entomological News* , a zoological expedition to Brazil was organized at the Museum of Zoology, University of Michigan, through the interest and support of Mr. E. B. Williamson, Honorary Curator of Odonata. The members of the expedition are Mr. Jesse H. Williamson and Capt. John Strohm, U. S. A., who planned to leave New York on December 15, 1921 to be gone about eight months. Particular attention will be given to Odonata, but insects of all orders will be collected and much attention will be devoted to the spiders, shells, reptiles and amphibians.

According to *Science*, the Heckscher Research Foundation for the support of investigation at Cornell University has made grants for entomological work as follows:—to Professor J. C. Bradley, $700.00 (and $450.00 supplementary) to cover cost of preparing illustrations and completing manuscript embodying investigations of the wing venation of Hymenoptera; to Professor J. G. Needham and Dr. P. W. Claassen, $500.00 for preparing a monograph on the Plecoptera of North America; to Professor C. R. Crosby, $700.00 for drawings of the genitalia of a group of spiders, the Linyphiidae, to be used in devising a natural system of classification of the species and to determine the limits of the genera and their affinities.

Mr. E. S. Tucker of the U. S. Bureau of Entomology and recently engaged in the study of cotton insects, died at Tallulah, La., December 10, 1921, aged 54 years. Mr. Tucker received his scientific training at the University of Kansas under the tutelage of F. H. Snow, V. L. Kellogg and S. J. Hunter. At various times he served appointments under the University of Kansas, the Texas Agricultural Experiment Station, the Louisiana Agricultural Experiment Station and the United States Department of Agriculture. His entire writings comprise a list of 118 papers published in various places. He was a charter member of the Entomological Society of America, a member of the Kansas Academy of Science and of the American Association of Economic Entomologists.

The annual meeting of the Crop Protection Institute was held at the Seneca Hotel, Rochester, N. Y., January 12, 1922 at two P. M. Professor W. C. O'Kane was elected Chairman, Paul Moore, Secretary and G. R. Cushman, Treasurer, for the coming year. A dinner was held at the Chamber of Commerce at 6:30 P. M. in which scientists, manufacturers and fruit growers joined, 123 in number. The speakers were Mr. H. E. Howe, Professor W. C. O'Kane, Professor L. R. Jones, Dr. R. W. Thatcher, Mr. G. R. Cushman, Dr. A. L. Quaintance and Professor P. J. Parrott. Other entomologists present were: Dr. E. P. Felt, J. G. Sanders, Professor C. R. Crosby, M. D Leonard, Dr. W. E. Britton, G. E. Sanders, F. Z. Hartzell, Hugh Glasgow, Fred Johnson, B. D. Van Buren, J. T. Haack, J. F. Palmer and G. H. McLeod. Many of these men were in Rochester to attend the meeting of the New York State Fruit Growers Association held on January 11, 12 and 13. Mr. H. E. Hodgkiss was reported as being present on January 11.

At the Toronto meeting, the Entomological Society of America elected officers for 1922, as follows:—President, Arthur Gibson, Dominion Entomologist, Ottawa, Canada; First Vice-President, Dr. W. A. Riley, University of Minnesota, St. Paul, Minn; Second Vice-President, Professor R. A. Cooley, University of Montana, Bozeman, Mont.; Secretary-Treasurer, Dr. C. L. Metcalf, University of Illinois,

Urbana, Illinois; Additional Members of the Executive Committee, Dr. J. M. Aldrich, United States National Museum, Washington, D. C.; Mr. William T. Davis, New Brighton, N. Y; Dr. E. M. Walker, University of Toronto, Toronto, Ontario; Dr. O. A. Johannsen, Cornell University, Ithaca, N. Y.; Managing Editor of the *Annals*, Dr. Herbert Osborn, Ohio State University, Columbus, Ohio; Editorial Board, Dr. W. S. Marshall, University of Wisconsin, Madison, Wis.; Dr. Vernon L. Kellogg, National Research Council, Washington, D. C.; Dr. F. E. Lutz, American Museum of Natural History, New York; Dr. William M. Wheeler, Bussey Institution, Boston 30, Mass.; Dr. E. M. Walker, University of Toronto, Toronto, Ontario; Dr. S. A. Forbes, University of Illinois, Urbana, Ill.; Dr. A. D. Hopkins, Bureau of Entomology, Washington, D. C.; Prof. A. L. Lovett, Oregon Agricultural College, Corvallis, Ore.; Dr. Frederick C. Muir, H. S. P. A. Experiment Station, Hawaii; Assistant Managing Editor, Dr. C. H. Kennedy, Ohio State University, Columbus, Ohio.

Apiculture

Mr. G. B. Gooderham has been appointed Dominion Apiarist as successor to the late F. W. L. Sladen.

The meeting of the American Honey Producers' League was announced to be held at Salt Lake City, January 30 and 31.

The North Carolina State Beekeepers' Association planned to hold its winter meeting at the State College, Raleigh, January 18 and 19.

Mr. O. A. Sippel formerly of the apiary division of the Ontario Agricultural College, has recently accepted an appointment as instructor in beekeeping at the Montana State College.

The meeting of the Oregon State Beekeepers' Association is scheduled to be held at Pendleton, Ore., January 26-27, 1922. Mr. H. A. Scullen, Corvallis, is the Secretary.

The annual meeting of the Pennsylvania State Beekeepers' Association has been arranged for January 24 and 25. at the time of the Pennsylvania State Farm Products Show at Harrisburg.

The meeting of the South Dakota State Beekeepers' Association was held at Mitchell, S. D., February 13-14, 1922. Mr. J. C. Tjaden, Vermillion, S. D., is the Secretary.

Mr. A. E. Lundie, an entomologist from South Africa, is visiting the United States, and is at present taking some research work at the Bee-Culture laboratory, U. S. Bureau of Entomology, to supplement the work in beekeeping which he is carrying on at Cornell University.

A fund is being collected from the beekeeping friends of the late Doctor C. C. Miller, the income from which will be used to establish a permanent library of apiculture, to be placed in the care of one of our leading educational institutions. Contributions of books and journals from individuals are welcome, as well as contributions of money from both individuals and associations. The committee in charge of the matter consists of C. P. Dadant, Hamilton, Ill., E. R. Root, Medina, Ohio, E. F. Phillips, Washington, D. C., E. G. LeStourgeon, San Antonio, Texas, and B. F. Kindig, East Lansing, Mich.

Department of Horticultural Inspection

Nests containing from three to six living larvae of the White Tree Pierid, *Aporia crataegi* L., were intercepted by Federal Inspector Joby A. McCutchin in shipments of fruit and rose stocks arriving at New York from Angers, France. Literature fails to record this insect as being established in the United States; and, to prevent the introduction of this pest, the Chairman of the Federal Horticultural Board has advised the Government Entomologist of France that plant material forwarded under French certificate must be free from the nests of this insect, as well as other pests.

The White Tree Pierid is reported to be a general feeder in Europe, injuring the foliage of fruit and wild rosaceous plants, as well as shade trees, including oak, mountain ash, willow, etc. It has from time to time been reported as occuring in Russia, Roumania, Sweden, Germany, England, Spain, France, etc. Records of the Federal Horticultural Board indicate that some sixty-two nests of this insect were intercepted on fruit and rose stocks arriving from France in 1921. The nest of White Tree Pierid is suspended from the infested twig by a silken thread, and this characteristic, as well as its size, will readily distinguish it from the nest of the Brown Tail Moth (see plate 3).

The Sorrel Cutworm, *Acronycta rumicis* L., was collected by H. J. Speaker, Ohio State Inspector, January 11, 1922, on Manetti rose stocks arriving from Angers, France. This cutworm has been intercepted on several occasions in years past, and an effort should be made by all inspectors to prevent its entry and establishment in the United States.

Manetti rose stocks from England and Holland have been found to be infested with *Emphytus cinctus* L. by Herbert F. Seifert of Illinois, and the same insect has also been taken by Q. S. Lowry of Massachusetts on stock arriving from France.

Sweet potatoes from Haiti in ship's stores of a vessel arriving at Philadelphia, were upon inspection, found to be infested with *Cylas formicarius* Fab. by Federal Inspector C. A. Davis. These tubers from Barbados were also found infested with *Euscepes batatae* Waterhouse in a vessel arriving at New York by Federal Inspector E. Kostal.

It is reported that a shipment of potatoes from Blackfoot, Idaho, which arrived at San Diego, California, was found upon inspection by a Plant Quarantine Inspector of the California Department of Arriculture to contain the Alfalfa Weevil. This was also found in alfalfa hay used for food in two cars containing race horses which were being shipped to Tia Juana.

In order to prevent the entry and establishment of the Mexican Cotton Boll Weevil in the state of Arizona, the Arizona Commission of Agriculture has authorized the placing of inspectors on the highways entering that state. The timeliness of this action was soon evident, since the Mexican Boll Weevil was found in a small collection of short staple cotton seed which was taken from an auto tourist shortly after the inspectors were placed on the roads.

On account of the possibility of introducing into the mainland subterranean or soil infesting insects, the Federal Horticultural Board has announced a public hearing to be held in Washington, March 7, for the purpose of considering the advisability of prohibiting the entry of sand, soil, or earth from the territories of Porto Rico and Hawaii.

Plants for distribution at the Plant Introduction Gardens of the Department of Agriculture located at Savannah, Georgia, Brooksville, and Miami, Florida, were inspected by Messrs. H. L. Sanford and J. A. Stevenson; those at Chico, California were inspected by Messrs. W. S. Fields and T. D. Urbahns; and those at Bellingham Washington, by Mr. A. G. Webb.

The fourteen-car fumigation house at Nogales, Arizona, which was erected by the Federal Horticultural Board, was completed early in the Fall and put into operation on December 1. At the present time, there are four Federal inspectors located at Nogales. The work at the port is in close cooperation with the Customs and Immigration Services, as well as the State Entomologist in Arizona. There were 19,977 cars fumigated on the Mexican Border from July 1 to December 31, 1921 inclusive, in contrast with 15,490 fumigated during the preceding fiscal year.

Professor Davis Lumsden, formerly professor of floriculture at the New Hampshire Agricultural College, and subsequently assistant professor of floriculture at Cornell University, has been appointed as horticulturist for the Federal Horticultural Board, and assigned to the Foreign Plant Quarantine Service.

Plate 3

Left: Nests of Brown-tail Moth Collected in New England.

Right: Six nests of the White Tree Pierid on Stock Arriving from France, Illustrating Method of Suspension. (Natural Size.)

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ESSENTIALS OF APIARY PRACTICE AND MANAGEMENT

By Morley Pettit, *First Ontario Provincial Apiarist, now Commercial Beekeeper, Georgetown, Ont.*

Beekeeping has to do with enduring colonies of short-lived insects. The colony, not the individual is the unit. Bees cannot be harnessed or trained like animals. Only inherited characteristics may be altered slightly by breeding. Their labor which is useful to man is performed primarily for the benefit of the colony; man appropriates the surplus. Apiary practice consists in so controlling the economy of the hive as to increase this surplus to a maximum. Altho bees are not harnessed or trained, the key word to successful practice is "Control." It is well established in beekeeping literature that strong colonies during the whole period of the honey flow are of the utmost importance. In recent years the willingness to work of these strong colonies has been equally stressed. Successful apiary practice secures the maximum surplus production of honey by controlling the condition of every colony, so that it has a maximum surplus population of vigorous willing workers during the whole period of the honey flow.

The year in the apiary is divided into Active and Inactive seasons. The former may be subdivided into preparation time and surplus-

storing time. One shades off into the other according to seasonal and colony conditions. The length of the inactive season depends on a number of conditions more or less under control. It is the aim of apiary practice to prolong the inactive season until activity will be of value, and especially to maintain rest at times when activity would be an actual menace to the well-being of the colony. When the time for profitable activity arrives it is the aim of apiary practice to encourage population increase to the utmost during the preparation time, then to maintain working morale and discourage the tendency to divide up the working force by swarming. If at the end of the active season the colony is in the best condition for the period of rest the beekeeper has done his full duty by his charge. The care of the surplus stores appropriated by the beekeeper is another matter.

The desirable characteristics sought in breeding honey bees are these: vigor, especially for honey gathering, but including resistance to cold or disease, quietness of nerves for good wintering and the comfort of the beekeeper in manipulations, contentment under conditions which tend to cause swarming, and length of life of the individual. The obstacle in the way of exact selection is the difficulty of controlling mating. For all practical purposes this is largely overcome by the use of good combs bringing drone production under control, and by mating the queens in fairly large apiaries where selection is constantly practised and best colonies allowed to produce drones freely.

The control of the colony in the Inactive Season is commonly called "wintering," and is discussed and analyzed copiously in all bee literature. The essential factors are three: the colony, the stores, and the shelter. The colony should consist of an ample number of individuals having a maximum supply of vitality, and having quiet nerves. The stores should consist of an ample supply of food containing a minimum of matter which the bee is unable to digest and assimilate. Since natural stores are very variable in this respect, the control of food quality is of the utmost importance. The writer has long contended that for a Northern winter every colony should be fed largely on sugar syrup after natural storing has ceased, and this point is coming to be generally conceded. He would venture now to go a step further and ask if the same procedure might not reduce colony activity when it is desirable to have activity suspended in warmer climates. By "shelter" is meant both the hive and its insulation from cold and protection from winds. The value of both packing and wind screens is undisputed; but the method of disposal of cluster moisture may be discussed. As a safe arrangement for a long cold winter the writer has found upward absorp-

tion the best method. This is provided by placing several layers of newspaper directly over the cluster and separated from it by a porous cloth to keep the bees from gnawing the paper. Upon the paper is a heavy layer of packing material kept dry by ventilation in the roof of the outer case. Any cluster moisture which may condense on the paper passes freely upward by absorption, but heated air does not readily escape as it does in ordinary systems of upward ventilation. This gives upward absorption insuring dryness with a minimum of upward ventilation and corresponding loss of heat.

The preparation part of the Active Season is devoted to rearing an abundant supply of workers. The essentials of management here are to insure a surplus of food, both honey and pollen, protection from cold as in winter, and plenty of worker comb space for brood. A queen moves upward into laying space more readily than downward, yet she hesitates to pass over sealed honey to this space. Using this principle we find it pays to winter in a Langstroth broodchamber with shallow super for stores. Early in the preparation period a second Langstroth broodchamber of dark worker combs is placed between the brood and the stores. This is only given to colonies which are ready for it and the queen occupies it at once, spreading out great sheets of eggs which the winter packing enables the colony to protect. Dark combs with unstretched cells acceptable to the queen especially next the top bar are preferred for breeding purposes. It is notable that even for storing honey, bees prefer dark combs, and much more so for brood. Every such preference should be recognized where possible. At the end of this period the brood chamber is reduced to one story again.

During the surplus storing period the beekeeper's duty is to prevent or control the swarming impulse, and failing that to prevent swarming, without allowing the working morale to be lowered. This calls for rather close supervision of colony conditions by someone with expert judgment. Entrance diagnosis is dangerous as it only reports lowered morale instead of forecasting it. One must watch internal conditions to prevent loss of working vigor. If absolute uniformity of stock and rate of development could be secured by breeding, treatment suitable for a whole apiary could be decided by examining a few hives. But not many apiaries have been brought to that state of perfection. In most apiaries it is profitable to see internal broodchamber and super conditions at regular intervals of time. The appearance of a colony in prime working condition is well defined:—Plenty of eggs and brood in all stages and no queen-cells, plenty of bees of all ages and no loafing, room for the queen to continue brood-nest development, and ample

super space for storage of honey in combs next above the broodchamber.

The swarming impulse usually appears when the queen begins to lag or the hive becomes uncomfortable through crowding or overheating. There is a difference which the queen record will show between queen resting and queen failing. The failing queen should be replaced at once with a young one. The resting queen, if her rest causes swarming impulse may be caged or placed in a nucleus for a time and the colony given a laying queen after it has had time to build cells and cap its brood. Except for special breeding purposes a queen which has had a journey through the mails should never be used; her remaining vitality is of too uncertain quantity. To allow the least slackening of storing zeal in any colony through crowding or any other preventable cause not only produces a temporary loss of surplus but lowers the working morale for the rest of the season. Contrary to prevalent teaching, the writer is firmly convinced that it is profitable for the commerical beekeeper to thoroughly examine every colony at least once in ten days during the storing period and give only such treatment as he finds each one needs, in preference to giving more radical treatment with the hope that it will produce a high state of colony morale during the remainder of the season. A comparison of results obtained from over five hundred colonies with the crops of larger beekeepers in similar localities bears out this conclusion.

With healthy colonies brought up to the storing season in the best of condition, maximum crops of honey are only secured by careful attention to the details of keeping up the highest morale or working zeal of every colony. As the key word of apiary practice is "Control," the key word of colony morale is "Contentment." This is maintained by reducing interference with normal colony conditions to a minimun, yet making that minimum of interference in the case of each colony of the exact nature and at the precise time that will do the most good.

The writer does not claim much if any originality in the ideas presented in this paper. No attempt has been made to exhaustively tabulate essentials of apiary practice. The purpose is only to call attention to some of the most important ones which may not be receiving as much attention in beekeeping literature as their value warrants.

THE CORRELATION BETWEEN SOME PHYSICAL CHARACTERS OF THE BEE AND ITS HONEY-STORING ABILITIES[1]

By J. H. MERRILL, *Apiarist, Kansas State Agricultural Experiment Station*

It has long been known that some colonies in a beeyard exceed others in the amount of honey they store. As a remedy for this condition, it has been urged to have all the colonies strong before the honey flow begins and to have them as nearly the same strength as possible. Yet, even when this advice has been followed, bees of the same race, raised from queens of the same age and strain, differ in the amount of honey that they store. In an attempt to learn why these facts exist, the following experiment is being conducted at this station.

During the summer of 1920, four colonies of bees, numbered 5, 6, 7, and 8 respectively, were selected to be used for this experiment. In 1921, the number of colonies used was increased to six and numbered 1, 2, 3, 4, 5, and 6. During both years the colonies selected were nearly equal in strength, the queens used were of the same age, and raised by the same breeder. Throughout both summers the same manipulations were made with each colony.

At the beginning of the summer the exact number of bees, the amount of honey in each hive, and the amount of brood were determined by a system of weighing. In July, 1921, a mid-season weighing was made before the main honey flow ended. In the fall of the year another weighing was made to ascertain the total amount of honey that had been stored in each colony during the season.

Collections were made daily of ten bees returning to each hive, and when possible a second collection was made during the day. These bees were then taken to the laboratory where the tongue (glossa) of each was measured, the amount of nectar in its stomach was weighed to determine its carrying capacity, and then the weight of the bee, together with its empty honey stomach and tongue was determined. During 1920, bees filled with nectar returning from the field were collected, and the nectar was weighed. Since nectar from different plants varies in specific gravity, it was decided in 1921 to allow the bees to digest the nectar which they had brought in, and then feed them with a sweetened solution of standard strength. During the summer of 1920, 2880 bees were examined and the results recorded. It was found that

[1]Contribution No. 74, from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 126 of the Agricultural Experiment Station.

there was a distinct correlation between certain physical characters of the bee and the amount of honey stored. This is shown in the following table.

TABLE I.—COMPARISON OF SOME PHYSICAL CHARACTERS AND THE TOTAL AMOUNT OF HONEY STORED DURING 1920

Hive number	5	6	7	8
No. of bees in spring	4th 12,500	2d 19,375	1st 20,000	3d 18,750
Length of tongue	4th	2d	1st	3d
Weight of bee	3d	2d	1st	4th
Carrying capacity	4th	1st	2d	3d
Total honey stored in pounds	3d 61⅜	1st 116⅜	2d 74⅛	4th 53⅜

Some of the significant facts brought out by this table are: First, the bees which have the longest tongues, the largest bodies, and the greatest carrying capacity are also the ones which form the strongest colonies in the spring. This fact will be emphasized when the results of 1921 are examined. It will be noticed that the colonies possessing the longest tongues, greatest bodies and largest carrying capacity exceed in the total amount of honey stored.

Colony No. 6, which ranked second in number of bees in the spring, second in length of tongue, and second in weight of bee, ranked first in the total amount of honey stored. Colony No. 7 ranked first, although it was approximately equal to colony No. 6 in the number of bees in the spring; was first in length of tongue, first in weight of bee, but was second in its carrying capacity and was second in the total amount of honey stored.

The following table shows the same results for 1921.

TABLE II.—COMPARISON OF THE CARRYING CAPACITY AND STORING ABILITY

Hive number	1	2	3	4	5	6
Total honey produced in pounds	4th 56⅝	6th 16½	1st 119½	2d 82½	3d 68⅜	5th 43
Carrying capacity in mg.	4th 19.59	5th 18.67	1st 21.63	2d 20.05	3d 19.89	6th 18.64

The above table shows a comparison of the total amount of honey stored in each hive and the average carrying capacity of the bees in those hives. The relative rank is indicated by the figures placed above the results. The colonies whose bees had the largest individual carrying capacity are the ones which stored the greatest amount of honey, and for the four highest there appears to be a direct correlation between the carrying capacity and the total amount of honey stored

during the entire season. The results of the 1921 season confirm those obtained in 1920, since the colonies which ranked first, second, third and fourth in carrying capacity also ranked first, second, third and fourth in the amount of honey produced. In 1920, the colonies that ranked first and second in the individual carrying capacity, also ranked first and second in the total amount of honey stored.

As the season of 1921 was the second during which this experiment has been conducted, naturally more data were collected than during the first year. The following table summarizes some of the most striking results obtained during the second year of this work.

TABLE III.—COMPARISON OF SOME PHYSICAL CHARACTERS AND AMOUNT OF HONEY STORED DURING 1921

Hive number	1	2	3	4	5	6
No. bees in hive June 15	5th 23,740	3d 35,625	1st 42,500	4th 25,000	2d 40,000	6th 17,500
Honey stored between June 15 & July 15, in pounds	3d 62½	5th 29⅛	1st 85⅜	4th 55⅜	2d 79	6th 24⅞
Average length of tongue in mm.	6th 3.57	3d 3.62	1st 3.86	4th 3.61	2d 3.84	5th 3.59
Average weight of bee in mg.	5th 82.1	3d 86.1	1st 93.6	4th 84.6	2d 86.5	6th 70.6
Carrying capacity in mg.	4th 19.59	5th 18.67	1st 21.63	2d 20.05	3d 19.89	6th 18.64
Total honey produced in pounds	4th 56⅝	6th 16½	1st 119½	2d 82½	3d 68⅜	5th 43

These hives were kept on platform scales throughout the season, and a record was made of the daily changes in weight, which indicated whether or not nectar was being brought into the hives. These records show that the main honey flow stopped on July 28, or 13 days after the mid-season weighing was made. Some very interesting facts were brought out by a study of the data, comparing the length of tongue, the weight of the bee, the number of bees which were in the hive on June 15, and the amount of honey stored during the heaviest part of the honey flow. Hive No. 3 was first in all of these respects; hive No. 5 was second, and hive No. 4 was fourth. Hive No. 2, which was third in number of bees on June 15th and third in length of tongue and the weight of the individual bee, drops to fifth place in its carrying capacity and also to fifth place in amount of honey stored between June 15 and July 15, and was sixth in rank in the total amount of honey produced for the season. Colony No. 2 and colony No. 6 were practically equal in carrying capacity and ranked sixth and fifth respectively in the total amount of honey produced. Colony No. 1, which was fifth in the number of bees, sixth in the length of the tongue, and fifth

in average weight, rose to fourth in carrying capacity, and stored the third largest amount of honey between June 15 and July 15, but was fourth in the total honey produced, which rank corresponded with its carrying capacity. Colony No. 3 exceeded all others in all of the factors here considered, and stored by far the largest amount of honey during the season. Colony No. 4 was fourth in the number of bees, fourth in the amount of honey stored between June 15 and July 15, and fourth in the length of tongue, fourth in the weight of the bee, but rose to second rank in carrying capacity and total honey produced. Colony No. 5 was second in number of bees, second in honey stored between June 15 and July 15, second in length of tongue, almost equalling colony No. 3, which ranked first in this respect; was second in the weight of the bee, but had a slightly smaller carrying capacity than colony No. 4 which ranked second in carrying capacity and total honey produced, and colony No. 5 ranked third in both of these respects. Colony No. 6 ranked sixth in every feature, except in the length of tongue and total honey produced. Its tongue length and carrying capacity were very nearly equal to that of colony No. 2, which ranked fifth in total honey produced.

These results seemed to indicate that the bees which have the longest tongues, largest bodies and greatest carrying capacities exceed, in the total amount of honey stored, those possessing these factors in a lesser degree. While there seems to be a direct relation between the length of tongue, the size of the bee when the carrying capacity is either equal or about equal, and the total amount of honey stored, yet a study of colony No. 1 would indicate that if it were deficient in the size of tongue and the size of bee, this disadvantage would be offset by the advantage of a larger carrying capacity, because, as previously mentioned, colony No. 1 ranked sixth in the length of tongue and fifth in size of bee, but in its carrying capacity it very nearly equalled colony No. 5 which ranked third in carrying capacity, and on July 15 colony No. 1 ranked third in the amount of honey stored, and at the end of the season ranked fourth in total honey produced. This is again shown in a study of colony No. 4 which ranked fourth in length of tongue and weight of bee, but second in carrying capacity and total amount of honey stored.

During both 1920 and 1921, those colonies whose bees possessed the longest tongues and had the greatest size or carrying capacity, were also strongest in the number of bees. This may be due to the fact that the length of the bee's life depends upon how rapidly its energy is expended. If the bees possessing the longest tongues, the largest size, and the greatest carrying capacities expend less energy to bring in

nectar, this may account for the fact that the bees in these colonies have longer lives and consequently are found in greater numbers.

In 1921, over 3000 bees were examined to determine the length of tongue, the individual carrying capacity, and the size of each bee. The data secured was arranged in frequency distributions and the coefficient of variability was determined from these distributions. This represented the probable variability of the group expressed on the percentage basis. The coefficient of variability in the size of the carrying capacity was larger than either of the other two characters. Consequently, in order to determine the number of individuals necessary to be examined to arrive at a definite conclusion, these figures will be based on the coefficient of variability for the carrying capacity. If ten percent is used as the difference to be measured, then the number of individuals required would be 32. In order to further safeguard these measurements, it seems advisable to examine 40 bees from each colony, as it appears that this number would be sufficient to be fairly representative and to give data accurately sufficient to form a definite conclusion.

Summary

A study of the data obtained in this experiment both in 1920 and 1921 indicates, first that there is a distinct correlation between the length of tongue, carrying capacity of the bee, and the amount of honey stored during the season; Second, that there is a distinct relation between the number of bees found in the colony in the spring and the size of the above named physical characters. Third, it is very strongly indicated that while it would be distinctly advantageous to a bee to excel in all three of its physical characters, yet if it is deficient in any of these characters, the disadvantage may be overcome if it possesses one of the other characters to a greater degree. Since the probable error for the coefficient of variability of each of these physical characters has been computed, it will be necessary to examine 40 bees from any colony in order to determine which colony of bees in a beeyard should be the best producer. As this examination can be made early in the spring, it will enable queen breeders to save one year's time in selecting the colony which they are going to choose for the best producing quality.

TIME AND LABOR FACTORS INVOLVED IN GATHERING POLLEN AND NECTAR

By Wallace Park, *Ass't Chief in Apiculture, Iowa Experiment Station*

Time Factors

Individual bees were marked and records kept of the time of departure and return of each marked bee. Observations began early each morning and continued without interruption until the bees ceased

flying at night. During most of the time there were two observers, so that the chances for a marked bee to pass unnoticed were reduced to a minimum. Only full strength colonies were used in securing data.

Nectar Gathering

Since honeyflow and weather conditions have such a direct influence upon the gathering of nectar, the time records secured under any given set of conditions are not likely to be duplicated except under similar conditions. During the period of observation in 1920, average colonies stored about five pounds per day from white sweet clover, *Melilotus alba*, while in 1921, average colonies gained only a little over one pound per day from the same source. Weather conditions were highly favorable for honey production in the former instance but were only fair in the latter. Summarizing, it may be said that one set of data was secured under very favorable conditions, whereas, the other was obtained under conditions which were from mediocre to poor. The data for field trips, hive stays and round trips have been plotted as frequency curves in which the records obtained under favorable and unfavorable conditions are compared.

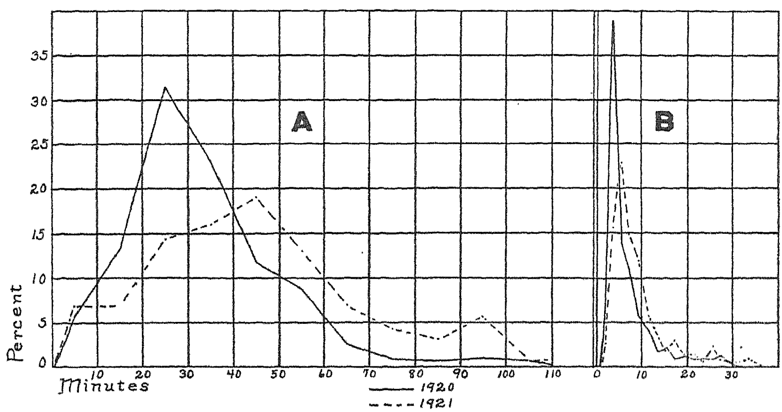

Fig. 3. Showing the frequency distribution of time records made by nectar carriers under *favorable* and *unfavorable* honeyflow conditions. A, Field trip records. B, Hive stay records.

Of the records obtained for field trips made by nectar carriers in 1920, 31 percent fell within the 21-30 minute class, as shown in Fig. 3, A. About 68 percent fell between 10 and 40 minutes, and 95 percent occupied less than 1 hour. The mean time was about 34 minutes but the modal or most frequent interval spent in the field was 26.8 minutes.

[1]Modal values have been determined by use of W. I. King's formula given in his "Elements of Statistical Method," p. 124.

In 1921, only 19 percent of the field trip records fell within the 41-50 minute class in which the peak of the curve appeared. About 48 percent fell between 30 and 60 minutes, and 76 percent were completed within 1 hour. The mean time for field trips was 49 minutes but the modal interval was 45 minutes.

As shown in Fig. 3, B, the 3 and 4 minute records of hive stays by nectar carriers comprised nearly 40 percent of the total number recorded in 1920. Over 75 percent were completed within 10 minutes. The average time for all hive stays was 11.6 minutes but the figure is not very significant owing to the markedly skew form of the curve. The modal or most frequent interval spent in the hive between field trips was 3.9 minutes.

In 1921, the records of hive stays were more widely scattered than in the preceding year. The peak of the curve fell within the 5-6 minute period which included only about 23 percent of the records; but nearly 68 percent were completed in 10 minutes or less. The mean time was about 16 minutes while the modal interval was 5.5 minutes.

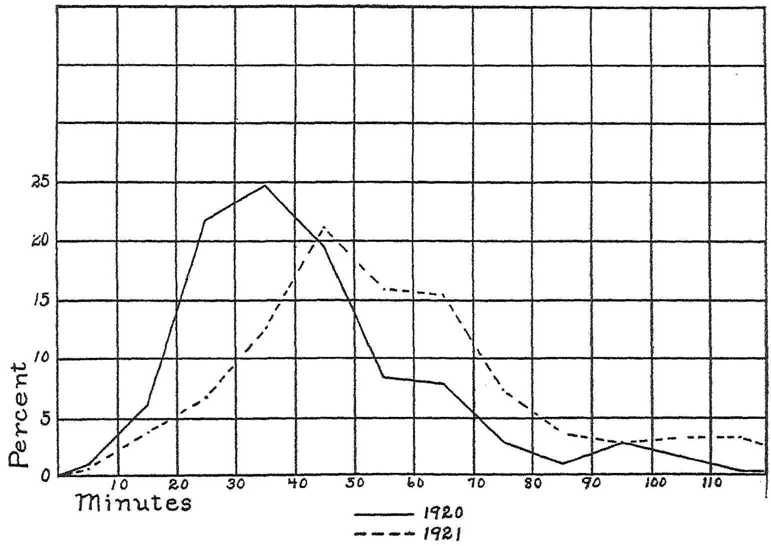

Fig. 4. Showing the frequency distribution of time records for round trips made by nectar carriers under *favorable* and *unfavorable* honeyflow conditions.

Nearly 25 percent of the round trips recorded for 1920 fell within the 31-40 minute period as shown in Fig. 4. Just 66 percent occupied between 20 and 50 minutes each, and 90 percent were completed in less than 1¼ hours. The mean time was 45 minutes, whereas, the modal or most frequent time was only 35 minutes.

In 1921, about 21 percent of the recorded round trips belonged in the 41-50 minute class. Scarcely 50 percent fell between 20 and 50 minutes and only 80 percent were completed in less than 1¼ hours. The mean time was 63 minutes but the modal time was 46 minutes.

The maximum number of trips recorded in one day for a nectar carrier was 24 in 1920 and 17 in 1921. The average number of trips per day was found to be 13½ in 1920 while in 1921 the average was only 7 per day. If the mean time for round trips for each year be multiplied by the average number of trips per day for the same year, we arrive at an approximation to the average time per day spent in nectar gathering. This gives about 8½ hours for field work in 1920 and about 7½ hours for 1921.

Pollen Gathering

Time records for field trips, hive stays and round trips by bees gathering pollen from corn were secured in 1920 and again in 1921. The weather conditions in both instances were favorable enough for the production of pollen by the plant and for field work on the part of the bees. But in 1920, the data were taken at times when there was an abundance of corn in bloom, whereas, in 1921, the main period of bloom had passed before the records were obtained. We have, then, as for nectar carriers, one set of data secured under favorable conditions, and the other under less favorable conditions. The records for the two seasons have been plotted against each other in the form of frequency curves which appear in Fig. 5, A. B and C. In every case the curve is a decided skew, so for purposes of comparison, the *mode* is used in preference to the *mean*.

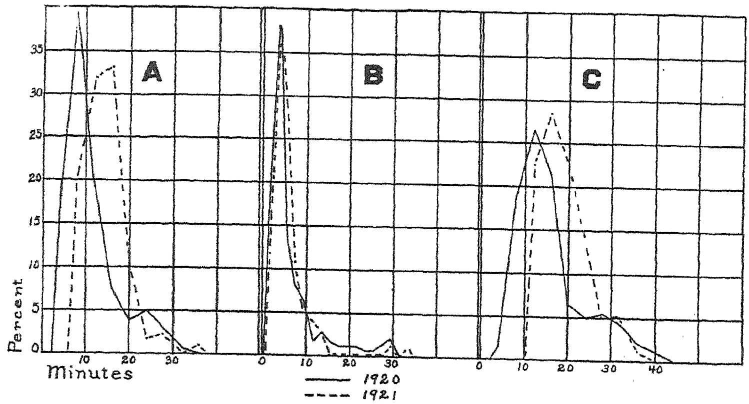

Fig. 5. Showing the frequency distribution of time records made by pollen bearers when gathering pollen from corn under *favorable* and *unfavorable* conditions. A, Field trip records. B, Hive stay records. C, Round trip records.

Field trips by pollen bearers were found to be considerably shorter as a rule than those made by nectar carriers. As shown in Fig. 5, A, almost 40 percent of the field trip records for 1920 fell within the 6-10 minute class, and 97.5 percent were completed in 30 minutes or less. None of the 1921 records for field trips fell within the 2-6 minute class, and only 20 percent fell within the 6-10 minute class, yet 99 percent were accomplished in 30 minutes or less. The modal time, however, was 15.5 minutes as against only 8.6 minutes in 1920.

The curves for hive stays appear in Fig. 5, B, and are very similar for the two seasons. The peaks both fell within the 2-4 minute class. In 1920, this class received 38 percent of the records as against 36 percent in 1921, but the percentage of hive stays that occupied 15 minutes or less was 98 in 1921 as against 88 in 1920. The most frequent interval spent in the hive between trips was 3.4 minutes in 1920 and 3.7 minutes in 1921.

In Fig. 5, C, we have the curves for round trips. The modal interval for the 1920 records was 12.6 minutes but was 16.5 minutes in 1921. The percentages of records falling within the modal class were nearly the same in both cases. In fact, the two curves are much alike as to area and shape, but the one for 1921 stands about 4 minutes farther to the right than does the other. This indicates in a general way that the bees that gathered corn pollen during the period of observation in 1921 consumed about 4 minutes per trip more than did those in 1920 when corn pollen was more plentiful.

The maximum number of trips recorded in one day for a bee gathering pollen from corn was 20 in 1920 but only 11 in 1921 while the averages were about 8 and 5½, respectively. As a rule, corn pollen was not available in the afternoon so these figures represented only about half a day in actual working time.

Labor Factors

Before the nectar carrying capacity of the honeybee could be found, it was necessary to determine the minimum flying weight. This determination was made by three different methods, all of which gave approximately 82 mg. as the average minimum flying weight for Italian bees. The load carried was determined by deducting this factor from the gross weight of the loaded bee. The maximum nectar carrying capacity was found to be approximately 70 mg. or about 85 percent of the weight of the bee itself. Average loads were found to weigh 40 mg. or about 50 percent of the weight of the bee.

The weight of pollen loads carried by bees apparently differs according to the source, ranging from 12 and 14 mg. for elm and corn, respectively,

up to 25 mg. for apple and 29 mg. for hard maple. Thus a maximum load of pollen was found to be about one-third of the weight of the bee and less than half that of a maximum load of nectar. It appears that there must be a great difference in the specific gravity of various pollens, for the loads carried from corn appeared fully as large as those from apple or hard maple, but they weighed only half as much.

STUDIES OF THE TEMPERATURE OF INDIVIDUAL INSECTS, WITH SPECIAL REFERENCE TO THE HONEY BEE

By Gregor B. Pirsch

(Withdrawn for publication elsewhere.)

THE COST OF POOR QUEENS

By F. B. Paddock, *Ames, Iowa*

In a previous paper[1] attention was called to the irregularity of colony production. Records were made in a yard in which colonies having queens from the same source produced from almost no surplus honey to a good crop. It was further pointed out that too large a proportion of colonies produced under a profitable or average crop. The estimated cost of these low producing queens was placed at $18 each, the market value of the honey they failed to produce under the yard average. It was suggested that perhaps queens were being sold which came from a low producing type. Individual record of performance was intimated as a relief measure for the present unsatisfactory honey yields.

The records made during the season 1920 were continued during the present season, 1921. The summary of the records for the two seasons is given in Table 1.

Table I.—Queen Records for 1920 and 1921.

Source	Date	Purchased	Lost	Replaced	1920 Season	1921 Season	1920 Crop	1921 Crop	Cost
I	Apr. 25/20	40	9	17-6	14	5	84	112	$3.50
II	Apr. 30/20	20	6	3	11	5	100	100	2.25
III	Aug. 11/20	6	3	0	3	3		120	2.50
IV	Aug. 14/20	12	5	4	7	3		60	5.00
V	Sept. 27/10	12	10	0	2	2		80	7.50
VI	Apr. 25/21	2	-	1		1		80	

[1]Jl. Ec. Ent. XIV. 1, pp. 101-105.

From the data given in this table it is possible to make certain deductions:

1. There is too much loss in queen introduction.
2. There is too much replacement necessary.
3. There is too low proportion of good replacement.
4. The cost of good replacements is very high.
5. Late fall requeening proved very unsatisfactory.

There are also questions coming from the experience of the two seasons:

1. How soon should a queen be replaced?
2. How can replacement best be made?
3. Are we getting low producing queens?

Of the queens from source I almost 25% were lost in introduction. These were introduced by the cage method, considered as nearly safe as any method which can be recommended to the average beekeeper. From source II 30% of the queens were lost when the cage method of introducing was used. In the two cases the introduction was made early in the spring and in some instances into 3-frame nuclei. However dandelion was in full bloom and requeening at this date is generally considered safe. The queens of sources III and IV were introduced during the first half of August, the period usually considered ideal for fall requeening in this locality. The introducing was done by the cage method into full colonies. The only possible cause for the high loss at this time was the nectar flow; honey was coming in but not in great quantities. In the case of source V the requeening was undoubtedly attempted too late in the season. At this time the nectar flow was over and early preparations for winter were under way. The queens of source VI were introduced early by the cage method, and into 3-frame nuclei. A moderate amount of feed was given to these nuclei which may have so changed conditions that the queens were accepted.

At the close of the 1920 producing season 17 of the 31 queens from source I were found to have given such poor results that they were killed. Eleven were replaced and the small amount of bees in the 6 remaining colonies were doubled with other colonies. Not only was a very large number of replacements necessary but what should have been 6 colonies disappeared from record. By the end of the 1921 season 9 of the 14 remaining queens gave such poor results that they were replaced. Of the queens from source II only 3 were found unsatisfactory during their first season and were replaced. However, during the second year 6 of those saved were replaced because the results of their colonies were unsatisfactory.

Then it can be said that some of the queens which give good results during their first season may be wholly unsatisfactory during their second year. Of the queens from source I there was a much higher proportion of replacement during the first season (almost six times) than in source II, while during the second season there was 64% replace ment in source I and 54% in source II. During the first season the production of source I queens was somewhat lower than source II queens, but during the second season the reverse was the case.

The queens of sources III, IV and V were used to replace those found unsatisfactory in sources I and II.

Of these fall introduced queens (III, IV, and V) there was much less replacement in general. The queens of source IV proved quite unsatisfactory as is evidenced by the decidedly poor production. The source VI queens were hardly satisfactory and 1 of the 2 was replaced. During the first season of production there was a 33% total replacement of the queens from these three sources. During the second season after replacement one year there was an average of 59% replacement of source I and II queens. The replacement of queens is therefore not nearly as assuring as one would wish since it has been found necessary to replace among the queens used for replacing unsatisfactory colonies.

The queens of each source were of the commercial quality known as "Untested." The definition for this grade of queen is reasonably well understood. The customary price received for such queens was $1.25 each or $15 per dozen. On this basis the queens worth retaining after loss of introduction in source I represented a cost of $2.50 each, source IV cost $5.00 each and source V cost $7.50. This cost is entirely too high and too variable.

The very poor results obtained in the introduction of queens in source V would seem to point clearly to the fact that requeening so late in the fall is wholly undesirable. At this time there is seldom any honey flow and the early preparations for winter are under way by the colony. In view of the experience during the 1921 season it seems quite probable that the date of introduction for source III (August 11) is even too late for certain results each year.

In the case of uncertain queens how soon should they be replaced by another queen? During the season of 1920 all of the queens had an opportunity to prove their quality throughout the entire honey flow. Even before the honey flow it was possible to say that certain queens were not doing as well as others or even as well as the average of the yard. However, these queens were given assistance in one way and

another during the season in the hopes that they would eventually become good producing queens. The assumption was then made that a poor queen at the start seldom makes any surplus crop. There is such a wide variation in the constitution of queens that some do well or even excellent from the very start. Others never seem to attain the record which the apiarist has reason to expect. Weekly examination of colonies even if not in detailed manner will certainly reveal some lagging colonies. Such colonies should be indicated and given special attention. If such colonies remain below the average condition for the yard for a period of more than two weeks they should be replaced. When the building up period of the spring is well under way, when the spring honey flow becomes reasonably constant, a queen which slows up for two weeks is of doubtful value. Certainly if this slowing up occurs later during the period preceding the harvest it is even more disastrous. From careful observation it would seem that a queen may start on the decline at any time and without apparent cause.

If production is carefully watched it is necessary to get a good queen in every hive as soon as a queen shows any signs of failing. To be in a position to do this a system of "queen reservoir" has been put in operation. This is merely a 2-frame nucleus in a standard hive which is divided into three compartments. During the past season it was found that practically every queen introduced by the cage method into a nucleus was accepted. These nuclei were often composed of frames of sealed brood with clinging bees from two colonies. In this nucleus it was possible to observe how different queens started off and of course the best were always used first for introduction into colonies. Carried farther the nucleus should be a "proving grounds" for queens and thus reduce the possible number of inferior queens which may find the way to the head of colonies to be later replaced. In this way the loss in introduction was greatly reduced in the process of getting good queens in every colony. The details of apiary management of this queen reservoir were worked out quite successfully and will be still farther improved and tested during the coming season.

The introduction of the entire nucleus into a colony gave almost perfect results during the past season. In this way when a poor queen is taken away from a colony a good queen already organized in egg laying is given to it. Thus the colony routine is not interrupted for even the shortest length of time. This new queen which has been selected as the best of several nuclei commences her enlarged efforts without the least restrictions. The apiary management of this method has proved its value in the effort to get good queens in every colony with the least possible delay.

The success of introducing queen into nuclei and the success of introducing nuclei into colonies is an efficient method of overcoming what is the present uncertain production in queens. From the evidence given in the table it must be concluded that the beekeeper is supplied with queens of very indifferent production ability. The ultimate cost of getting a high producing queen in every colony is entirely too great. When a queen is purchased there is little assurance that she will prove of much value for honey production. She may have to be replaced and in turn the second and third replacements may prove unsatisfactory. The record of performance of the parents must be considered carefully before much performance can be expected of offspring.

FACTORS AFFECTING THE SUCCESS OF AMERICAN FOULBROOD CAMPAIGNS

By S. B. Fracker, *Madison, Wisconsin*

It is a truism that the control of each distinct infectious disease constitutes a separate problem. The factors on which solution depends are many, including the means of distribution of the causative agent, immunity, education and civilization of the persons affected, and the relation of the disease to commerce and industry.

In the case of every disease, scientific effort is directed first toward the discovery of a cure for the individual victim; second, to the means of protecting other individuals from attack. Measures to prevent widespread epidemics develop last, and often require an elaborate study of the many factors in the situation before success is attained.

Methods of "curing" the individual colony of bees suffering from some form of brood disease were worked out more than a generation ago when it was found that taking the infected material away from the bees constituted a successful treatment. Developments during the past ten years in the control of European foulbrood constitute at once an improvement in method and a confession of failure. The discovery of varietal resistance and the ability of a strong colony to carry on its own public health activities relieves the beekeeper of serious worry about this disease, although the adoption of control measures on this basis is an admission of his inability to prevent its continued distribution.

American foulbrood, on the other hand, wherever established, promptly develops a "vicious circle" which perpetuates infection, resulting in some places in the destruction of the apiary industry. In the absence

of resistant races, the original method of the artificial elimination of infected material remains the only known means of saving the diseased colony.

Policies Adopted in Different States

Beekeepers suffering from an ever increasing loss from this source are trying four different methods of large scale control. First, attempts are being made in several states to "educate" the average beekeeper in the hope that enough of them will voluntarily apply prophylactic measures to result beneficially to the general welfare. The second means consists of inspection on request or suspicion and the requirement of a clean-up when disease is discovered. Florida is trying a third policy, that of putting inspectors into the field who are themselves destroying every colony which shows disease, together with all infected equipment. A fourth method, the one with which the writer is associated, consists of the inauguration of clean-up campaigns county by county, in which the work begins with educational measures and a survey of every bee-yard in the county, and ends with the destruction of material remaining infected after the campaign has progressed two or three years.

A study has recently been made of the results in various Wisconsin counties in an attempt to measure the factors affecting the success of this method of control. The fact that the data are drawn from the inspection records since 1918, of from 800 to 1,400 different apiaries per year, enables us to eliminate many of the individual differences, reduce the probable error and arrive at averages.

Some of the problems considered included the average rapidity of progress in disease control, the results of treatment as compared to destruction of the infected colonies, the effect of urban and rural locations on the incidence and control of disease, the relation of the size of the apiary and the experience of the beekeeper to success in treatment, the apparent sources of new infection, and the means by which disease was inadvertently retained in the apiary year after year.

Transportation of Second-hand Material

It was clear from early studies that the most important source of new infection consisted in the sale and transportation of bees and infected apiary equipment. This data has already been published, together with an outline of the regulations adopted to control it. The requirement that no bees or used bee supplies shall be moved or sold without a permit or inspection certificate has placed an effective obstacle in the way of this means of distribution.

Honey as a Source of Infection

With this source eliminated the first question was whether the introduction and sale of honey, bottled and otherwise, through the regular channels of trade would bring back disease into clean yards as a result of the exposure of the containers after they are emptied. This has not proved to be a serious matter. In fact nearly every Wisconsin city has remained free from American foulbrood until infected apiaries were introduced. Diseased yards were of course moved into certain cities, including Madison and Fond du Lac, years ago, but such places as Eau Claire, Superior, LaCrosse, Manitowoc, and Racine are still apparently free from this disease, while Sheboygan and Antigo have received infection in recent years through the introduction of diseased yards.

Another form of evidence on this point is the fact that reinfections are not occurring in serious numbers. The exact figures on this point are before me for only Milwaukee and Jefferson counties. Out of a total of 503 different yards inspected and reinspected during a three year campaign, a total of 180 were infected. During this period in the two counties only nine apiaries which were free from infection at first, developed disease from all causes during the campaign. Only half of these were inside the city limits of a city of over 1,000 population, although over 95% of the grocery and interstate honey business of the two counties was carried on in such places. The nine yards mentioned include all apiaries which might have been infected but were missed by the inspector when examined the first time, as well as those in the immediate vicinity of infected yards where the bees robbed out infected honey.

Treatment Compared with Destruction

Inspectors have always felt some doubt regarding the permanent effect of prescribing treatment rather than destruction for diseased colonies. Successful disease control in individual colonies, however, proves to be the rule rather than the exception, that is, American foulbrood may be retained in the yard but is almost without exception, eliminated from the treated colony.

Comparing the results of treatment and destruction, I find that in four counties, Dane, Jefferson, Milwaukee, and Calumet, we have the foulbrood record since 1918 of 163 infected apiaries in which we know the control method employed by the beekeeper. Of these, 64 applied the shaking treatment, while 99 destroyed their infected colonies, repeating as often as necessary. Among those who treated the diseased colonies less than one-half (27) had yards free from foulbrood at the

1921 inspection, showing that the others spread disease during treatment, or stored infected material where the bees had access to it. Among the beekeepers who destroyed the infected colonies, only one-fourth still had disease in their yards this year.

Over large areas the difference in result is great. In only one county could we say that the beekeepers have failed in their attempt to control foulbrood. That is a county which insists on *treating* infected colonies, and judging from the records the beemen of that county will still be "shaking bees" long after their neighbors have forgotten such disagreeable topics as bee diseases. In the other three counties named the number of infected colonies has been reduced to 3% of the total number examined and beginning in 1921 all infected colonies and material have been destroyed by inspectors as fast as discovered.

How is Disease held over?

In examining the records of apiaries which retain infection in spite of treatment, one is struck by the average size of the yard. Of all those beekeepers who failed to eliminate infection in three seasons, only two own less than ten colonies of bees and most of the yards are from thirty to one hundred in size.

This points the way to a solution of the problem. In large yards the honey house is full of infection; floor, tables, tools and extractor are daubed with diseased honey; many unsuspected extracting combs contain foulbrood bacilli; and after the bees are shaken, infected material is stored for a day or two before destruction. During the past season bees have been found gaining access to infected honey in supposedly bee-tight honey houses through the stove-pipe in one case, the keyhole in another, and through a crack in the cement floor in a third. It is still more common to discover a missing windowpane, a crack in the siding or a door often left open. Once the bees get in they have no trouble leaving, either through bee escapes at the windows or through the door as the owner goes back and forth.

The storage of infected material in the honeyhouse for even a few days is one of the largest factors in maintaining disease in the yard. Judging from experience in Wisconsin, it is a much more common source of danger than carelessness in handling the diseased colony itself, and in the serious nature of the results ranks with the failure to isolate infected supercomb.

The largest yards of all have more trouble with extracting combs than from any other source. Two beekeepers, one with 250 colonies, the other at one time owning over 700, have recently suffered serious

loss as a result of mixing the combs from diseased with those from healthy colonies. The first, through systematic selection seems to have successfully isolated the infected combs from the others in two years, but the second let his yard go down to less than 300 colonies before he finally gave up, and melted 100,000 combs.

Effect of Weather Conditions

As outside influences which may affect progress, the most important have been the effect of weather conditions on the honey flow. It is of course out of the question to allow the average beekeeper to apply treatment when no nectar is coming in. The summer of 1918, for example, was entirely without honey over a large section of the state. No pressure was placed on the beekeepers to destroy their infected colonies, they dared not treat, and as a result slightly more American foulbrood was found in 1919 in the areas begun the previous season than had been reported at the first inspection.

Rate of Progress

Progress in area clean-up work seems to follow a definite course when allowance is made for various outside influences. For example, in Jefferson and Milwaukee counties together, a total of 503 apiaries have been inspected, of which 323 have never been found with American foulbrood. Of the remaining 180, nearly one-half (86) showed disease in 1918 or 1919 but have been clean since. Of the other half, 44 were still infected in 1920 but were clean in 1921. Of those showing disease this season (50), 17 were either new yards which had been missed before, were outside the area covered in previous years, or had been free from disease at a previous inspection.

Beginning with 1919 the result has been a fairly uniform reduction of about 50% a year, in all heavily infected areas. Theoretically such a ratio would bring us to a single infected yard in each of these countie by 1923 or 1924, but it is hard to anticipate the results of the more drastic attack made on the few remaining diseased yards when the total number becomes reduced to a small percent.

The rate of reduction just given applies to all counties except Dane, in which many large infected apiaries are selling quantities of infected honey in their own locality. Here the amount of reinfection is discouragingly high, being related apparently both to honey sales and to the more pronounced economical tendencies of the beekeepers in this area. In Dane county the shaking treatment is used uniformly, and the same state of mind which keeps most of the beekeepers from destroying

the occasional infected colony, bees and all, also causes them to save every doubtful bit of equipment. That state of mind is fatal to success in the treatment of bee disease.

Summary

To summarize, the factors governing the success of area clean-up campaigns are as follows:

1. Successful prevention of the sale or movement of used bee supplies.
2. Willingness on the part of the commercial beekeeper to take a few more steps than the absolute minimum requirement, even at a temporary sacrifice to himself.
3. Thorough cleaning of honey houses and preventing even the temporary storage of infected material in the apiary.
4. If treatment is being used, seasonal conditions which make treatment practical.
5. A persistent follow-up inspection, year by year as long as any infection remains.

When these factors are present and satisfactory, it is possible to reduce the amount of disease in large, heavily infected areas at a rate which should free them completely from disease in a reasonable length of time.

RELATION OF CLIMATE TO BEEKEEPING MANIPULATIONS

By H. F. Wilson, *Madison, Wisconsin*

Very few beekeepers realize the important influence of weather on beekeeping manipulations. It is true that this matter has been agitated more or less for a number of years but very little serious thought has been given to the subject. A study of weather records for different sections of the United States shows that there is a more or less definite set of conditions for the average year and with a proper knowledge of these conditions, our beekeepers can judge to a better degree what the spring, summer, fall and winter conditions are likely to be for their particular neighborhood.

It is true that there is a considerable variation so that in some years one might be very badly mistaken in his program. On the other hand it appears that certain weather conditions are more or less regular as for instance, in examining the weather records for the past ten years at Madison, Wisconsin, we find that there is a certain definite time, namely, March 10 to 15 when we may expect the first regular spring thaw and between March 20 and April 1 of each year, we know there will be a few days when the temperature is sufficiently high and the sun shining so that the bees can fly freely.

The relation of weather to placing bees in the cellar and setting them out again in the spring is important, far more so than our beekeepers will at first believe.

The Relation of Weather to Fall Conditions

Beekeepers in general differ a great deal regarding the proper time for putting bees in the cellar but usually they wish to wait until after the bees have had their last flight which keeps them out until after Thanksgiving or longer. As a rule this is a very bad practice, for too often the last flight never comes and if we are to take full advantage of the bee cellar the bees should not have to remain out-of-doors for two or three weeks of very severe weather at the beginning of the peroid of confinement. Our observations show that bees may safely take a flight on a sunny day when the temperature is 48° F in the shade. They do not normally fly on cloudy days, at much higher temperatures. Bees in the shade will not normally fly at 48° F. We find in comparing the weather records for the past ten years that on this basis bees had suitable weather conditions for a flight only three years of the ten after the first of December, the latest dates being December 4, in 1913 and December 13 in 1920. During the same period the bees might have had a flight only five times after the 20th of November and three of these years were the same as for the December flights. In 1915 a suitable day for a flight did not occur after November 13.

If the weather is warm during the fall and up to the last of November the bees are likely to have a day suitable for a flight near December 1. But if there is a heavy snowfall in October or about the first of November there is likely to be no opportunity for the bees to fly after November 20. It is quite evident then that bees have only a slight chance for a cleansing flight in December and less than half a chance after November 20. For this reason the beekeeper should plan to put the bees in the cellar not later than November 20 except in seasons where little or no snow has fallen previous to that date. Following that period the bees should be put in the cellar with the first snow storm.

The season of 1920 was far from normal and bees might have been left out of doors until December 20. However, bees in the cellar previous to that time were in no need of a flight and bees in outdoor cases did not fly to any great extent.

Relation of Weather to Spring Conditions

The time when bees should be set out in the spring is generally based upon the blooming of the willows and the majority of our bee-

keepers plan to remove the bees between April 1 and April 15. A few beekeepers remove the bees as soon as the snow disappears.

Here again the weather records of the past ten years give us an indication of how early the bees may be removed to advantage.

Bees should not be taken out while the ground is covered with snow. During the eight of the last ten years the temperature was high enough at Madison so that the bees could have had a cleansing flight between the 10th and 15th of March if the snow was melted away. However, the snow does not usually disappear before the fifteenth of March and after that time a suitable day for a flight is not likely to occur before the twenty-third. Practically every year a warm spell occurs between the twenty-second and the twenty-sixth of March so that if the bees need a flight they may be set out on the twentieth or sooner. with the assurance that they will be able to fly within a few days. In one year out of ten they may be able to fly before March 10. During the same period there was one year when a flight was not possible until March 26.

If bees are known to be short of stores they should be set out during the warm spell in March and given an abundance of sugar syrup to carry then over until the time when they can gather nectar in the field.

During the winter the temperature surrounding the cluster will be held at 57° F. as long as the bees have stores and energy to live, regardless of the cold outside. During that time the temperature may go below the zero point for a short period at a time, but it will range mostly from 20° F. or higher. The bees are then only required to develop an approximate average of thirty-seven heat units. In addition, they are not at that time required to use energy in the production of wax and food for the young.

As soon as brood rearing starts in the spring the temperature inside the cluster and around the young brood is increased to 90 to 95° F. At the same time the temperature will in the northern states run about 40° F., with fluctuations during March and April up to 65° F. Under those conditions the bees are forced to produce energy which will keep the temperature up to that of brood rearing, a difference of thirty to fifty heat units. During that time an excess of energy is also being used in producing larval food and possibly other products.

A practical illustration of how temperature influences the development of brood in the spring may be demonstrated by watching three colonies of minimum, medium, and maximum strength. By May the weak colony will have only a small circle of brood indicating the inside space covered by the cluster. This will also be more or less true of the medium colony, but the area of the brood nest will extend beyond the ordinary

winter clustering space. In the strong colony the brood nest will be several times larger than the winter clustering space and several frames may be filled from end to end. It is, of course, a recognized fact that strong colonies in the spring are able to build up strong for the honey flow.

In the northern states bees are often removed from the cellar and placed in exposed locations where the north and west winds sweep over them, causing a loss of temperature which can only be made up by extra work on the part of the bees and a consequent loss of energy which should be conserved for a greater expansion of the brood nest. The month of April is nearly always cold and the night temperatures frequently drop to near the freezing point. Whenever a cold wet spring occurs the bees have great difficulty in building up and always reach the honey flow in poor condition unless protected.

MEMORIAL RESOLUTION

The members of the Section on Apiculture now in session at Toronto do hereby resolve:

That whereas Mr. F. W. L. SLADEN, the late Dominion Apiculturist who was prominent in Scientific Research work in Apiculture, and

Whereas Mr. Sladen met his sudden death while carrying on research work in apiculture, and

Whereas the late Mr Sladen and his work were well known to most of the members of this Association, that the Secretary of this Section convey to the members of the late Mr. Sladen's family the sympathy of this Section.

Section of Horticultural Inspection

Friday, December 30, 1921

The meeting of the Section of Horticultural Inspection of the American Association of Economic Entomologists was called to order at 10:00 A. M., December 30, 1921, at the University of Toronto by the Chairman, Mr. A. G. Ruggles of St. Paul, Minnesota.

CHAIRMAN RUGGLES: The fiıst paper on the program is an address by the Chairman.

ADDRESS OF CHAIRMAN

By A. G. RUGGLES, *St. Paul, Minn.*

For a horticultural inspector from the Middle West to address a meeting of this kind seems more or less presumptuous. In Minnesota we have very little of the real inspection work to occupy our attention.

The burdens of inspection fall to the inspectors to the east, south and west, particularly at coast points. These inspectors guard us and all we have to do is to watch for the stray insect wanderers. When we see what a task it is for the Californians and Floridans and the inspectors of the Federal Horticultural Board at the ports of entry, our work seemingly amounts to very little. And yet, I believe it is of such importance that it cannot for a minute be neglected.

In my opinion the policy in a state like Minnesota should be threefold.

FIRST—The educating of the nurserymen and dealers who grow plant stock to the necessity of being on the lookout for and to detect if possible important injurious insects and disease forms.

SECOND—Eliminating or absolutely controlling the injurious forms already present in the state.

THIRD—Maintaining quarantines to keep out or retard pests as long as possible, in the meantime putting on an educational campaign until the people get acquainted with the methods of control. For a state's clientele the logical sequence in maintaining strict quarantine regulations is as follows:—Education, gaining the good will and cooperation particularly of the nurserymen, and then the maintenance of any regulatory order. If the good will of the nurserymen is obtained cooperation in the enforcing of any quarantine is more easily acquired.

In furthering this program we have made it a practice in season and out of season to talk to nurserymen individually and collectively whenever possible on the desirability of being on the watch for pests and on the wisdom of trying to keep the areas into which they ship free from any new plant disease or insect. As we all know it is hard to prove to the nurserymen the necessity of submitting to certain detailed quarantines. As the nurseryman, as a rule, is one of the most intelligent men in the community, if we have a sensible program and he believes in us, the problem is half solved at the start. It will take time and patience on our part but we firmly believe in this method. We do not believe that it is necessary for a nursery inspector to be looked upon simply as a police officer. We try to rid the nurserymen of the idea that the inspector is trying to find something on the premises sufficient to avoid giving a clean "bill of health." We have always insisted that our inspectors hunt scrupulously for the bad pests but also when these were found that he help the owner on every occasion to eliminate the forms and at once if possible; that he talk the matter over with the owner and convince him that such and such a course is the one to pursue. Fortunately, we have had only a few instances when drastic measures were required.

One year we found San Jose scale in two or three nurseries. We assisted and advised in destroying, spraying and fumigating so that this year not a single scale was found in the nurseries of the state. At the present time we have a very bad infestation of the common oyster shell scale in the orchards, and a few nurseries of the state. Altho not as harmful a scale as San Jose we have insisted that the scale be eliminated from nursery stock. We have helped in three instances in the destroying and spraying of these trees before they were offered for sale. In our work with the White Pine Blister Rust we have caused to be destroyed large numbers of black currant and white pine and established a policy for the white pine nursery grower that currants and gooseberries must be grown at least half a mile from the white pine. Before we were sure that this disease had spread so generally thruout Minnesota, we caused to be destroyed many more plants of Ribes than we would advocate at the present time and yet we have had no "come back" from our growers. The idea is that if we do all we can to keep a disease or insect in check with the knowledge that we have at the time and play the game with our cards on the table, the nurserymen will stand back of us.

Being alert for all new forms and keeping our insect and plant disease survey as efficient as possible will certainly help in preparing for any emergency. Some insects are bound to get in, in spite of quarantines and other restrictions. For instance, *Crioceris asparagi*, was taken for the first time two years ago in a nursery near our eastern boundary. This insect, from reports of its spread this year, will be in a few years a pest of asparagus in Minnesota. A year ago in some gladioli bulbs from Holland we found an insect which is a bad pest of onions in Europe. It is impossible that we caught the only specimens of the insect, and if our climate is suitable, this insect must soon be added to our list of onion insects in the state. We do not know what the European Corn Borer will mean to us but we are getting prepared for it.

Reviewing our experience with the pests found in nurseries of the state, the question often arises as to just what has been accomplished in keeping these forms in check. It seems to me it simply amounts to this "to be forewarned is to be forearmed." In spite of our disarmament conference there are some things that we shall always have to fight, our principal weapon in all cases being "education" of ourselves and our constituents.

It is also possible in much of our fight against bad pests, at least in Minnesota, that we have had nature on our side. Even with the San Jose scale it may be that it will not live over a series of years with us. Some preliminary experiments seem to show this. Several years

ago we found a nest of the brown tail moth in a French importation. The caterpillars in this nest were alive and healthy, and were carried to maturity in the insectary. This is the only one we ever found. It does not seem possible that this was the only nest of live caterpillars of this insect which ever entered the state. As some experiments in eastern Canada seem to show, a very cold winter will kill the larvae. We often have very cold winters in Minnesota.

It would be a fascinating subject to think about and discuss what might have happened had Congress passed a quarantine act fifty years before 1912, with how many less pests would we have to contend today: or with how many less would we have to contend if Congress had passed a quarantine act in 1898 the year after Dr. L. O. Howard's recommendation. These are very interesting subjects but not all pertinent to the present. The pests that are here now are the ones we are interested in; these and their control, and the methods by which we can prevent any more pests entering the country are the subjects which most appeal to us at this moment.

CHAIRMAN RUGGLES: The next paper on the program is by R. W. Harned and H. H. Kimball.

THE SWEET POTATO INSPECTION SERVICE IN MISSISSIPPI

By R. W. HARNED and H. H. KIMBALL, *Agricultural College, Miss.*

So far as we know Mississippi was the first state to inaugurate a state-wide compulsory sweet potato inspection service. For several years the necessity of such an inspection service had been felt. This need had been emphasized by the large losses due to preventable sweet potato diseases that were being distributed throughout the State in seed sweet potatoes and sweet potato plants, and also by the danger of carrying the sweet potato weevil into uninfested sections of the State.

We do not feel that the Mississippi State Plant Board has started anything new or deserves any credit for any originality in this matter. The idea probably originally came to us while reading about certified Irish potatoes in other parts of the country. Probably a year before the Mississippi sweet potato inspection service was started, the State Plant Board of Arkansas under the direction of their Chief Inspector, Professor G. C. Becker, was urging the use of certified sweet potatoes for planting purposes. In fact, Professor Becker had a well organized sweet potato inspection service, but it was entirely voluntary. Anyone in Arkansas who wished to produce certified seed sweet potatoes could

have his potatoes and potato plants inspected by applying to the Arkansas State Plant Board and by paying certain fees. Early in the spring of 1920, while our plans for starting a sweet potato inspection service were still in a rather nebulous condition, the Cotton States' Entomologists had a meeting at Vicksburg, Mississippi, where in a personal conversation with Professor Becker we learned for the first time about the sweet potato inspection service in Arkansas and we immediately proceeded to adopt nearly the same system in Mississippi. Details of the Arkansas sweet potato inspection service may be found in Circular No. 9 of the Arkansas State Plant Board, Little Rock, Arkansas.

The chief difference between the two inspection services are that in Arkansas it is voluntary with the grower. A man may buy or sell certified seed sweet potatoes or may not do so and the growers of certified sweet potatoes must pay for at least a part of the inspection service. In Mississippi, it is illegal to sell or ship seed sweet potatoes or sweet potato plants that have not been inspected and certified. Every grower who expects to sell sweet potatoes for planting purposes must have his sweet potatoes and sweet potato plants inspected and certified. This service is paid for by the State and is rendered at no cost to the grower, except that he must pay for the numbered certificate tags that are issued at actual cost.

The sweet potato inspection service is very similar to the nursery inspection service. We adopted the numbered certificate plan that has been so satisfactory in our nursery inspection work,—one of the many excellent ideas that we copied from the State Plant Board of Florida. If at any time any serious disease or insect pest should be found attacking the sweet potatoes of any grower who has sold plants or potatoes for planting purposes, we can promptly locate all properties to which shipments have been made by this grower.

During 1921 each grower was required to send promptly to the Plant Board office a copy of the invoice accompanying each shipment of potatoes or potato plants. This invoice gave the name and address of the consignee and of the consignor, the quantity and variety of potatoes or plants and the number of the Plant Board certificate permit that accompanied the shipment. This was satisfactory except that there was no uniformity about the size, shape and appearance of the invoices sent in and there was often considerable delay in sending the invoices. To overcome these troubles, during 1922 the permit certificate tags will be made up of two parts each containing the same number. These parts will be divided by a perforated line so that they can be easily separated. Both parts will contain the same information—name and address

of consignor and consignee, quantity and variety of potatoes or plants and permit number. The tag part containing the eye will be attached to the shipment and the other part will be mailed at once to the Plant Board office.

The chief aims of the sweet potato inspection service are (1) to prevent the further introduction and spread of the sweet potato weevil (*Cylas formicarius*), of Black-rot (*Sphaeronema fimbriatum*), and of Stem-rot (*Fusarium batatatis*) (2) to control, reduce and if possible in time eradicate these troubles from the state, and (3) to prevent the introduction and spread of any other sweet potato pests that occur in other parts of the world, or that we may not know of at the present time.

The inspection service has been given plenty of publicity through the agricultural, daily and weekly papers that circulate in the state, by the county agents and by the railroads. Several posters have been issued that have been put up in public places in all parts of the state. The first two posters were copied from the Arkansas Plant Board posters through the courtesy of Professor Becker. Later, posters illustrating black and stem rot and the sweet potato weevil were issued.

The sweet potato weevil is only known to occur in the four southernmost counties of the State and a separate eradication campaign against this pest has been conducted for several years in cooperation with the U. S. Bureau of Entomology. Satisfactory progress has been made in eradicating this pest.

Black-rot and Stem-rot are quite generally distributed over the State and for years had been causing increasingly larger losses each year. Some farmers had stopped raising sweet potatoes, as their losses from disease had been so great as to make it unprofitable to try to raise them. It was common to hear men say that they had lost 50% or 65% or even 80% of their potatoes because of black-rot. We believe that losses of this kind are now a thing of the past in Mississippi. One interesting instance came to our attention only a few days ago. In a certain community last spring, all the farmers except one planted certified seed and took all the precautions that are recommended to avoid Black-rot. There was one farmer who said he did not believe there was anything to all that foolishness about preventing diseases and went ahead without taking any precautions. This fall when the farmers in this community hauled their potatoes to the community storage house the only one who had black-rot among his potatoes was this one man who did not believe in the inspection service. In another county a man who did not believe in the inspection service went over into another state in his automobile and smuggled in his supply of sweet potato plants. This fall the

diseased potatoes were so numerous in his field that he decided that it would not pay to even dig his potatoes. These men have probably learned to have a little respect for the inspection service.

Before seed sweet potatoes can be certified they must be inspected *at least* twice,—once in the field and once in storage. Potato plants to be sold must be grown from certified seed and besides these, seed must be bedded under the supervision of an inspector of the Plant Board, and must be inspected at least once not more than three weeks before any plants are removed from the bed.

The inspection service may be considered under three headings: (1) Field Inspections, (2) Storage Inspections, (3) Bed Inspections.

FIELD INSPECTIONS. A 10% infection of stem-rot at time of field inspection prohibits certification of seed. If less than a 10% infection of stem-rot is found all diseased hills are dug up and both vines and tubers burned under the supervision of a inspector who advises the grower to treat diseased spots in the field in the same manner that he treats his potato frame and beds in the spring—i.e.: apply corrosive sublimate or copper sulphate solution. Fields showing less than a 10% infection of stem-rot at first field inspection are re-inspected just before the potatoes are dug for the purpose of destroying all hills developing infection after the first field inspection was made.

STORAGE INSPECTION. Potatoes that are to be sold for planting purposes must be separated from eating potatoes before inspector arrives. (We urge field seed selection at digging time and the storage of seed potatoes as far away from the bulk of the crop as possible.) If black-rot or stem-rot is found during the storage inspection, and the grower still desires to sell a part of his crop for planting purposes, he must cull out all diseased potatoes from his seed stock and arrange for a second storage inspection at a later date.

When the field and storage inspections of a grower's seed sweet potatoes have shown them to be apparently free of serious diseases and insect pests, application is made to the State Plant Board for Seed Sweet Potato Permit Tags. The application is accompanied by an affidavit covering a number of points, among them the following:

The grower agrees to use permit tags on all seed sweet potatoes that he disposes of within the State of Mississippi. He agrees to dispose of only such seed sweet potatoes as have been inspected by an agent of the State Plant Board, and found to be apparently free of serious diseases and insect pests. He agrees to carefully inspect all sweet potatoes that are disposed of for planting purposes, culling out every potato showing the least sign of disease. He agrees to destroy all culled potatoes by

fire or to use them for eating purposes or to boil them thoroughly before feeding them to stock. He agrees to dip all seed sweet potatoes just before disposing of them for 10 minutes in a solution of corrosive sublimate—strength one ounce to 8 gallons of water.

BED INSPECTIONS. Beds must be made of soil in which sweet potatoes have never before been grown, and if old frames are used they, as well as implements used in preparing the beds, must be thoroughly disinfected. Sweet potato draws are certified under the following conditions:

Only such potatoes as have met the requirements for Mississippi certified seed sweet potatoes are used to produce plants to be sold or given away within the State of Mississippi. All certified seed used to produce plants are hand culled and disinfected immediately before bedding out, this is done under the supervision of an inspector of the State Plant Board. All beds of certified seed sweet potatoes are inspected by an agent of the State Plant Board not more than three weeks before plants are to be removed from the beds.

Growers outside of Mississippi must comply with the same standards met by Mississippi sweet potato growers before permit tags are issued that will enable them to ship into the state. The quarantine and parcel post inspectors located at about 20 strategic points throughout the state give us an opportunity to check very closely the movement of plants into and within the state. All diseased and uncertified plants are held up.

We believe that we have an effective inspection service and that the results have fully justified the hopes we had at the start.

MR. HASEMAN: I should like to ask Mr. Harned if the inspectors shown on the map are full time inspectors or part time.

MR. HARNED: We hope they are full time inspectors. The legislature convenes next month and if they treat us as well as they did before, they are full time inspectors.

MR. G. M. BENTLEY: We in Tennessee think this is a very important measure. We have a similar department, except possibly a little in addition; for example, supervising of the seed, seeing that the seed is dipped, the frames and so forth carefully treated, and that the plant beds have the proper environment.

Most of you know that the South is hard hit at this time. Cotton, farm products, and live stock are low in price, and the sweet potato is the one product not so affected. The demand for the slips is very great, not only in the state of Tennessee, but in the States of Arkansas and Mississippi, and the growers of Tennessee are intensely interested in these requirements. There are four counties in the state which, if they

pass inspection, can live upon the millions of slips shipped out. Our growers consider it a very important step in the agricultural problem, and this is something too that will influence a great many of the Northern states, since the sweet potato has been found to grow well, and profitable yields have been made in that section.

I think we should all express our confidence in the measures adopted by Mr. Harned in the state of Mississippi.

Chairman Ruggles: If there are no more remarks, we will pass on to the discussion of a paper presented at the Chicago meeting by H. F. Dietz, "Some Problems in Greenhouse Inspection in Indiana."

Mr. Sasscer: I purposely put this paper on the program in the hope that it might provoke some discussion. Unfortunately, Mr. Dietz' paper was read last year at the end of the session, and there was little or no time for discussion.

I don't know how much problems of this kind affect state inspectors, or how far you attempt to go into inspection of materials distributed from greenhouses. We in Washington, however, are seriously concerned about this problem.

As many of you know, the Department of Agriculture is constantly introducing new plants from remote parts of the world. During the past ten or fifteen years we have intercepted many insects new to this country, and it is impossible to tell what would have been the result if they had been allowed to become established.

Our practice is to examine this material carefully in the inspection house upon arrival, and if there is the slightest doubt as to whether there is any danger, or if an insect new to us is found, the material is either burned, fumigated, or otherwise treated, and grown in what we style a "quarantine house." As soon as the danger has disappeared, this material is allowed to go to the field station at Bell, Maryland. We have taken the stand that it would be taking an unnecessary risk to allow material to leave the Bell greenhouses without an inspection at the time of shipment.

I might say that the greenhouses at Bell, at the present time, so far as we know, are infested with only the common greenhouse insects, but it frequently happens that we have a new pest under our eyes for six or eight months and do not recognize it as such. For that reason we are carefully inspecting the plants, not a month or seven weeks before, but at the time of shipment.

Temperature conditions in a greenhouse are comparable to the tropics. An inspection today is not good two weeks hence. I should like to have some expression as to whether or not the inspectors representing the

various states at this meeting are of the opinion that we are taking unnecessary precautions. Would you be willing to accept the material which is distributed from the greenhouses in question with one inspection a year, or two or three inspections a year; or do you think we have adopted the right policy in inspecting at the time of shipment?

If we are going to ship material from a greenhouse, what kind of a certificate should we use? Are the state inspectors going to accept qualified certification? Would you accept plants from us if you knew they were infested with the common greenhouse insects? As most of you no doubt know, we now have a law in the District of Columbia which requires that all plants entering should be inspected and certified. We have an inspector at the post office, the express office, and the freight office, and during the past two months one hundred and twenty-two shipments have passed through the post office and express office which did not bear certificates of inspection, and thirty-five of these shipments were infested with common greenhouse insects such as the common mealy bug, greenhouse white fly, etc.

I think I am safe in assuming that very few, if any, of the states are inspecting, and if they are, they are not certifying material which is distributed from greenhouses.

MR. F. N. WALLACE: I would like to ask Mr. Harned if they are going to pay attention to greenhouse stock down in Mississippi.

MR. HARNED: All plants coming into the state have to go to one of the parcels post inspection stations and are there inspected. We have six of them in the state. Our quarantine inspectors get most of the things that come in on trains, greenhouse plants included.

MR. J. J. DAVIS: At a meeting at La Fayette last winter, of the entomologists of Missouri, Illinois, Ohio, and Indiana, this matter was briefly discussed, and in our mimeographed report we made a statement regarding greenhouse inspection work. I don't recall the exact statement, but it was to the effect that very probably we could divide the insects of the greenhouse into two distinct classes—those generally distributed throughout the United States, and those which had a comparatively local distribution. In discussing this matter, it seemed desirable that those with local distribution should be restricted; that is, that plants infested with the insects of local distribution be restricted from shipment, and that restrictions should also apply to our common insects where the infestation was serious. But where the infestation was very light and normal, there probably need be no further restrictions on shipments from state to state.

Mr. Sasscer: Mr. Harned, do you certify greenhouse stock?

Mr. Harned: In Mississippi at the present time we are inspecting the greenhouses. If we find anything of a serious nature, we quarantine that greenhouse until it is cleaned up. If we find any of the common insects very abundant, we require them to clean up before they can continue selling plants. But we are not certifying any of them at the present time. We have that matter under consideration and we are doubtful as to the best way of handling it.

Mr. Wallace: Is the date of your inspection put on the shipping tag?

Mr Harned: We are not issuing shipping tags to the greenhouses. We are inspecting them and letting them do business locally. If they are shipping things out by mail, they have to have a permit to do so, and that is also true with express. But we are letting them sell locally without permits.

Mr. Wallace: We inspect our greenhouses if a man wants to ship, but I will be perfectly frank in saying that the inspection tag, when it says that it is free from insect pest or plant disease, doesn't mean a thing. It means that we were reasonably sure that there was nothing injurious at the time we inspected.

But as Mr. Dietz made plain, a man might bring in something from another greenhouse the very next day and reship it under his tag. It is not only in Indiana but I think that thing is happening in all of the states. We don't want to start anything in Indiana and penalize our greenhouse men; and if it is not feasible with all the states we don't want to start it. I can't stop our men from shipping. They send up to Chicago and get the plants there. Or, as happens now, we can sell to a broker in Chicago and he resells to another broker, who ships it out and the man who buys it doesn't know where it comes from.

Mr. P. A. Glenn: We are puzzled in Illinois to know what to do with our greenhouses. Our law eliminates greenhouses from inspection and they are not required to be certified, but in some of the states they require certificates in order that our greenhouse men may ship stock into those states. One particular state has asked me to issue to certain greenhouses a certificate covering a year. I hardly see how a certificate could be issued on a greenhouse covering a year. They really ought to be inspected every two or three weeks, or every shipment that goes out ought to be inspected. Every shipment ought to have an effective inspection. But it has been our practice in Illinois, when greenhouses wanted to ship to another state where they require inspec-

tion, to issue to our greenhouses a certificate reading like this: that they are practically free from the usual greenhouse pests and are apparently free from danger.

Of course, if a greenhouse has scale all over its palms, we refuse to issue them a certificate at all for palms. Or, we require them to agree not to ship any palms under a certificate we give them, and the certificate will apply only to stock in their greenhouses which seems to be free from scale or insect pest. We issue certificates to only those greenhouse owners who seem to take all the reasonable precautions to keep down the common insect greenhouse pests. It would be an awful job in Illinois to inspect every shipment that is sent out from greenhouses; in fact, it would be impossible.

MR. T. J. HEADLEE: I have felt for a number of years that the handling of the greenhouse stock situation should be given attention, and if Mr. Sasscer believes that the information that we now have on the different species of insects as to dangerous character, has gone far enough, I would like to make a motion that a committee be appointed, to throw this whole matter into some sort of definite shape for consideration at the next meeting. But I would like to have Mr. Sasscer answer the question first, as to whether he feels that the information along this line has gone far enough to permit reasonably fundamental action.

MR. SASSCER: Doctor Headlee has asked a question that I don't believe I am competent to answer. If anyone had told me several years ago that the strawberry root worm would have become a rose pest in greenhouses, I would have been inclined to doubt him. Take the chrysanthemum midge for example. We fought desperately to keep it out of the Washington greenhouses, but it finally became established.

The great difficulty, it seems to me, is to determine what is an injurious insect in a greenhouse. Some five or six years ago the Bureau of Entomology initiated a project for the purpose of studying insects infesting ornamental plants in greenhouses, and a large mass of data has been assembled. Previous to undertaking this problem, Mr. J. J. Davis had been working up a bibliography of greenhouse insects, and he was generous enough to turn it over to us. However, there are a great many insect pests in greenhouses at the present time of which we know little. I am afraid that I am not in position to say that we know enough about greenhouse insects to lay down a definite rule that will hold for five or ten years.

MR. HEADLEE: I believe I will make the motion anyway, because we are in very much the same boat in all lines of insect work. I don't

know as much about them as I should. So I move that a geographically representative committee be appointed by the Chair with Mr. Sasscer as chairman, to take this matter under consideration and see whether any general rules, fundamental principles and recommendations can be laid down, this committee to make its report at the next session of this section.

Mr. S. B. Fracker: I second the motion. A number of our men in Wisconsin keep a little outside shrubbery in order that they may be entitled to carry a nursery inspection certificate, and they attach it to greenhouse plants when requested to do so by the express agent. This is true particularly of inter-state shipments. The problem, we have felt, was a serious one, not only owing to the dangers from some of the insects mentioned by Mr. Dietz, but in other ways. For example, the orchid weevil, *Cholus cattleyae*, has been distributed from one greenhouse to another by means of stock, and its distribution could probably have been prevented if inspection certificates had been required. It is an insect which is perfectly ruinous in the orchid houses when it once becomes established.

The motion of Mr. Headlee, seconded by Mr. Fracker, was voted upon and carried.

Chairman Ruggles: The next paper on the program is "Important Foreign Insect Pests Collected on Imported Nursery Stock in 1921." by Mr. E. R. Sasscer.

IMPORTANT INSECTS COLLECTED ON IMPORTED NURSERY STOCK IN 1921

By E. R. Sasscer, *Washington, D. C.*

Exclusive of bulbs and seeds, 27,507,929 plants were introduced during the fiscal year 1921 from all foreign countries in compliance with Regulations 3 and 14 of Quarantine 37. Of this number, 21,172,-049 plants arrived from France, the remainder being distributed among all other countries exporting to the United States. In spite of the emphasis which has been repeatedly made regarding the necessity of shipping only plants free from soil or earth, a number of shipments of plants, the roots of which were in part embedded in soil, arrived. Moreover, in several instances the soil included in the matted roots of Astilbe from Holland was found to be infested with the larvae of *Brachyrhinus sulcatus* Fab. which would have escaped the notice of the inspectors if the soil had not been detected, removed, and carefully

examined. While these larvae were for the most part in the soil, in some cases they had entered the clumps and occasioned some injury to the roots. In all of the shipments it was evident that an effort had been made to remove the soil, but the small amount remaining was sufficient to protect the larvae and permit them to accompany the plants. While it is true that the insect in question is known to be established in certain sections of this country, this instance forcibly emphasizes the possibilities which accompany the introduction of plants imbedded in soil.

Forty-two shipments of French fruit and rose stocks were found to harbor nests of the Brown Tail Moth in contrast with sixty-three from the same country during the past eight years. Incidentally, a number of these shipments also contained nests of the White Tree Pierid (*Aporia crataegi* L.). One shipment of fruit seedlings from Holland was infested with nests of the Brown Tail Moth and one consignment of quince stock from France contained egg masses of the Gypsy Moth. Larvae of the Sorrel Cutworm (*Acronycta rumicis* L.) were collected on quince, cherry, and rose; and pupae of the Dagger Moth (*Apatela auricoma* Fab.) were reported on pear, quince, and rose from France, and cherry from Holland. Narcissus bulbs from Holland were infested with the Lesser Bulb Fly (*Eumerus strigatus* Falln.); iris from England with *Anuraphis tulipae* Boyer, and *Lilium candidum* from France with *Cryptothrips dentipes* Reut. Egg masses of the European Lackey Moth (*Malacosoma neustria* L.) were intercepted on three shipments of French apple seedlings, and cocoons of *Emphytus cinctus* Linn. were taken on rose stocks from England, Ireland, France, and Holland.

The Black Fly of Citrus, *Aleurocanthus woglumi* Ashby, was collected on the foliage of citrus on nine occasions from Cuba and Jamaica, and once on what appeared to be bay from the Bahama Islands. In a majority of these cases, the eggs and pupae were on leaves attached to fruit found in the stores of ships arriving at American ports of entry. *A. spiniferus* Quaintance also arrived on citrus leaves from Japan. The Mexican Fruit Fly (*Anastrepha ludens* Loew) was intercepted in mangoes and sweet limes confiscated from immigrants at El Paso, and larvae of *A. fraterculus* Wied. were found in mangoes and Cuban plums from Cuba, Mexico and Jamaica. The Mediterranean Fruit Fly was taken on five occasions in coffee berries from Hawaii, and what appeared to be larvae of *Conotrachelus perseae* Barber was located in avocados from Mexico and Costa Rica, as well as a species of *Heilipus* from Mexico and *Stenoma catenifer* Walsh from the Canal Zone and Mexico. Mango seed from Hawaii exhibited the Mango Weevil (*Sternochetus mangi-*

ferae Fab.), and sweet potatoes from Cuba and Mexico contained *Cylas formicarius* Fab., and shipments from Jamaica, the Bahama and Madeira Islands were infested with *Euscepes batatae* Waterhouse. *Metamasius sericeus* Oliv. was intercepted in sugar cane from Cuba found in ships' stores and in banana leaves in banana shipments from Costa Rica. The pink bollworm (*Pectinophera gossypiella* Saund.) was intercepted in cotton seed from England, Egypt, India, and on twenty-three occasions in cars arriving from the interior of Mexico.

Azaleas from Japan, introduced in accordance with Regulation 14, Quarantine 37, were in a number of instances found to bear injured buds. Repeated futile attempts were made to collect the insects responsible for the hollowing out of the buds. Samples of the injured buds were forwarded to Dr. S. I. Kuwana who advised that it was the work of the larvae of *Earias rosifera* Butler, which is reported to have two generations a year, the adult moth of the first brood appearing in April or May, and the second brood in July. The moth of the last brood deposits its eggs near the flower buds, and the larvae infest the buds shortly after hatching, and become full grown in September or October, hibernating in the larval condition in cocoons in the soil or between decayed leaves. In view of the fact that the exporting season in Japan is from November to April, and that the insect is in the soil or in old leaves at that time, and further that these plants are shipped absolutely free from soil, it appears that there is little likelihood of introducing this pest.

The Noctuid genus *Earias* contains some two dozen or more closely allied and similar species, several of which are known to be of primary economic importance; for example, *E. insulana* Boisduval, which is the well known Egyptian Cotton Bollworm, and is second only to the Pink Bollworm in the amount of injury it occasions to cotton in that country. *E. chlorana* Hubner is another injurious species feeding on willow in Europe.

The following is a list of some of the more important scale insects arriving on plants from various countires:

Coccid	*Host*	*Origin*
Asterolecanium urichi Ckll.	*Guiliema speciosa* (Palm)	Brazil
Chaetococcus bambusae (Mask.)	Bamboo	China
Lecanium coryli L.	Cherry cuttings	Germany
" " "	Apple scions	Czecho-Slovakia
" " "	Prune (cuttings)	"
" " "	Cherry (scions)	"
Pseudococcus gahani Green	*Tricuspidaria dependens*	England
Pseudococcus maritimus (Ehrh.)	Bananas	Central America

Coccid	*Host*	*Origin*
Ripersia palmarum Ehrhorn	Cocoanuts	Raratonga, Cook Isl.
" " "	"	Hawaii
Aspidiotus spinosus Comst.	Rose	Bahama Islands
Aspidiotus subsimilis Ckll.	*Persea americana*	Ecuador
Aspidiotus subsimilis var. anonae Houser	*Areca sp.* (Palm)	Cuba
" " " "	Sour sop	Bahama Islands
" " " "	Unknown	Cuba
Chrysomphalus scutiformis Ckll.	Bananas	Central America
Odonaspis inusitata (Green)	Edible bamboo	China
" " "	Bamboo	"
Odonaspis sp. (apparently new)	*Arundo mauritanica* (Rhizomes)	Algeria
Targionia sacchari (Ckll.)	Sugar cane	Bahama Islands
" " "	" "	Br. Honduras
Targionia sp.	*Populus subintegerina*	Algeria
Chionaspis inday Banks	Cocoanuts	Hawaii
Lepidosaphes ficus Sign.	Fig	Italy
Lepidosaphes tuberculata Malen	Orchid	England
Lepidosaphes mcgregori Banks	Cocoanuts	Singapore
Phenacaspis eugeniae Mask	"Kukui" nut	Hawaii
" " "	Mango	"

Summary of Countries and the Number of Species of Insects Reported by State and Federal Inspectors During the Calendar Year 1921 Up to and Including December 23

Algeria	4	Colombia	6
Antigua	1	Cook Island	3
Argentina	12	Costa Rica	10
Assam	1	Cuba	80
Australia	9	Czecho-Slovakia	4
Austria	1		
Azores	3	Ecuador	13
		Egypt	4
Bahama Islands	28	England	42
Bermuda	21		
Brazil	20	Fed. Malay States	4
British Guiana	12	France	51
British Honduras	6	Germany	6
British West Indies	6	Gaudeloupe	1
		Guatemala	16
Canada	4	Haiti	7
Canal Zone	10	Hawaii	49
Canary Islands	2	Holland	35
Ceylon	2		
Chile	9	India	32
China	33	Ireland	5

Isle of Pines	3	Salvador	1
Italy	82	San Domingo	7
Jamaica	50	Seychelles Islands	1
Japan	47	Siam	14
Java	10	Sicily	1
Jerusalem	1	South Africa	14
		Spanish Honduras	35
Madeira Islands	7	Spain	13
Malta	1	St. Kitts	1
Manchuria	1	Straits Settlements	8
Martinique	1	Sweden	5
Mexico	64	Syria	1
New Zealand	4	Tahiti	1
Nicaragua	7	Trinidad	4
Norway	4	Tripoli	1
Palestine	3	Turkey	1
Panama	12	Turks Islands	1
Paraguay	4		
Philippine Islands	17	Uruguay	4
Porto Rico	10	Venezuela	6
Portugal	2	Virgin Isl.	3
		Windward Isl.	1

CHAIRMAN RUGGLES: The next paper is by Mr. McLaine

A BRIEF RESUME OF NURSERY CONDITIONS IN HOLLAND, BELGIUM AND FRANCE

By L. S. McLaine, *Ottawa, Can.*

During the early summer of 1921 the writer had the pleasure of visiting France, Holland and Belgium. The main object of the trip was to se some of the larger nursery sections, as well as to look into the methods employed by the various governments in the inspection of nursery stock for export, particularly to North America. Unfortunately only a very short time could be alloted to any one locality or country, thus making it impossible to secure any definite first hand knowledge of the insects that are likely to be imported on exportations of plants or plant products. The writer, however, was impressed with the serious effort that was being made, in most instances, to inspect thoroughly all export shipments and to see that only healthy plants were shipped under the certificates of inspection.

The situation of the nurserymen on the continent, from a financial standpoint, is by no means enviable at the present time. During the war their business was at a standstill, and to-day it is little

better. Their trade with Russia, Germany and the central European countries is gone, and with the other countries there is keen competition and unending difficulties on account of disturbed trade relations and rapid fluctuations in exchange.

The nurseries on the continent are for the most part owned by old and well established firms whose business has been handed down from father to son for several generations. The nurserymen with whom the writer came in contact were men who took a pride in their craft and in the way the nurseries were cultivated and cared for.

Holland

The nursery districts in Holland are widely separated and each district usually specializes in one particular type of stock according to the soil or climatic conditions. The seven main nursery sections are located in the following districts and specialize in the plants mentioned below:

Veendam—Fruit stocks.

Hillegom—Lisse—Sassenheim—Bulbs and Peonies.

Boskoop—Ornamentals, Rhododendrons, Boxes, Laurels, Roses, Hardy Azaleas, etc.

Nardeen—Clipped and fancy Boxes and Yews, Lilacs and Ornamentals.

Oudenbosch—Fruit seedlings.

Zeeland—Forest seedlings.

Aalsmeer—Cut flowers.

The writer was only able to visit the Hillegom and Boskoop districts, and the headquarters of the inspection service located at Wageningen.

Bulb District. A large area in the vicinity of Hillegom and Lisse is devoted to the growing of bulbs and one of the larger firms has about six hundred acres devoted to their cultivation. Intensive cultivation was noted throughout the entire district, and as the best land is exceedingly valuable, it is not allowed to remain idle for any length of time. The soil is of a light sandy nature; the fields are small, usually protected by wind breaks and are separated by small canals. The bulb land s manured heavily every five or six years, and a field crop grown the first year after manuring. The bulb crops are rotated each year; at first tulips, then daffodils, etc. Two crops of the same species are never grown on the same land two or more years in succession.

The Dutch government has maintained a phytopathological laboratory at Lisse for the past five years, where extensive experiments are being carried on in connection with the diseases of bulbs. In 1910 a serious disease of narcissi and daffodils was found in this district. According to Dr. Van Slogteren, the expert in charge of the investiga-

tional work, the disease is caused by eel worms. When the disease is found in a bed, the diseased bulbs, all the healthy bulbs in the vicinity as well as the earth are removed and burned. Experiments have proved that the soil can be freed from the disease if bulbs are not planted on the same land for a number of years, but the value of the bulb land prevents this; furthermore, it takes years for the complete disintegration of all parts of the affected bulbs. Dr. Van Slogteren also stated that experiments with heating bulbs in warm water at 40° C. for a number of hours killed the eelworms and did not injure the propagating qualities of the bulbs; further experiments in connection with the effect on the forcing qualities are now being carried on.

Meredon sp. is reported as being rarely a serious pest but it does occur occasionally however in fields that are too well protected by wind breaks.

Boskoop. This is the centre of the ornamental trade and approximately two thousand acres are devoted to the growing of nursery stock. Previous to the war this acreage was divided among three hundred nurserymen, the majority of whom were small growers. There are now about twenty large firms in the district, holding from ten to fifty acres and up, of land. About one hundred and fifty firms do a direct export business and the remainder sell their plants to the larger firms. The nursery industry was first started in this district two hundred years ago. The nurseries are laid out in narrow strips, between canals, averaging 150-300 feet wide and from one-quarter to a third of a mile long. They appeared in most excellent condition, were free from weeds and no sign of either the gipsy or brown tail moths were seen.

Plant Inspection Service. The organization of the Phytopathological Service has been outlined in a special bulletin prepared by the service[1] so it is unnecessary to consider it in detail at this time. The nurseries are inspected frequently throughout the summer, and instructions are issued to the growers to spray or carry out any other treatment when such is considered necessary. If the instructions are followed a "general certificate" is issued to the grower, without which he may neither dispose of his stock locally nor secure an export certificate. Written records of all certificates are kept, and if for any reason a grower can not account for all the certificates forwarded to him, no additional certificates are issued until a satisfactory explanation is furnished. In the Boskoop district the local government requires the

[1]The Phytopathological Service in the Netherlands, No. 13, 1921. Wageningen, Holland.

spraying of all boxwoods during the winter months. A so-called "spraying brigade" has been organized to take care of the work on the smaller holdings.

Serious outbreaks of the brown tail moth are reported as unusual in Holland, although they do occur occasionally in the Limburg district. The gypsy moth is reported as rare.

Belgium

The great greenhouse district in Belgium centres around Ghent and Melle. Before the war this was a very prosperous community, with fine ranges of greenhouses, good packing sheds, etc., but as this area was occupied by the Germans from the summer of 1914 until 1918 business was practically at a standstill. During the occupation many firms were unable to obtain any coal for their greenhouses, whereas, others could secure only a sufficient quantity to maintain a temperature of between two and four degrees centigrade in their houses during the coldest weather, consequently many lost heavily. The growers in this area devote their attention almost entirely to the propagation of azaleas, palms, araucarias, aspidistras and rhododendrons.

Great care is taken in the preparation of the soil for the propagation of azaleas. The soil in which they are grown is of a heavy peaty nature, and brewers or malt grains are used as fertilizer. The slips are planted in pots in the spring, and grafted in August. The plants are kept in greenhouses during the winter, placed outside in May and returned to the greenhouses in September. While outside they are often covered with mats or frames to form partial shade. The plants are examined several times during the season and packed for export in the nursery rows. The larger firms propagate from twenty to fifty thousand azaleas a year. The majority of growers in this district do not export but sell their products to the larger firms.

Belgian Inspection Service. The inspection service is organized on a similar basis to the corresponding service in Holland, and was started in 1912 as a result of the United States quarantine brought into effect that year. The Chief Inspector is stationed at Ghent and has a number of inspectors associated with him. The nurseries are inspected at least twice each year and a report as to their condition is submitted to the Chief Inspector. If this is satisfactory, the nurseryman is furnished with a "general certificate," without which he may not dispose of his stock, even locally. The "general certificate" must be produced before an export certificate is issued. The stock is then re-examined at the time of shipment and if found clean the shipper is furnished with the export certificate.

FRANCE

The great fruit seedling nurseries are located in the vicinity of Orleans and Angers in the Loire district. The chief plants grown for export are fruit, rose and conifer stocks, although ornamentals, grafted and budded roses and perennials are grown in very large quantities.

In the Orleans district the number of firms that really do an export business does not exceed ten, whereas there are about five hundred growers altogether. All the large growers contract with farmers in the surrounding district to grow fruit stocks for them. About twelve hundred and fifty acres of land are devoted to the growing of nursery stock. One firm propagates one million fruit stocks, and three million roses a year; they also graft about six hundred thousand, and bud two hundred and fifty thousand roses. The small cultivators grow about ten million seedlings a year.

In the Angers district which is larger in extent than the foregoing, there are about six large exporters and about fifteen hundred to two thousand small cultivators.

The apples are grown from the seed of wild native apples, planted broadcast in beds very early in the spring (February), as soon as they are well started they are transplanted to beds and placed in rows, and are usually sold as one or two year transplants. The seedlings are dug in November, and packed and shipped in February.

FRENCH INSPECTION SERVICE. The inspection service is divided into two main divisions (1) entomological, (2) phytopathological. The entomological service is in charge of a Director with headquarters at Paris. The service is further divided as follows: (a) inspectors, who visit the various nurseries which have plants for export, and see that the latter are free from pests, they also deliver the certificates; (b) the assistant inspectors act as general assistants to the inspectors in their work; (c) the controllers are resident in the district to which they are attached; they pay special attention to the general condition of the plants. During the summer one controller and two inspectors were stationed at Angers and two inspectors at Orleans. All the nurseries are inspected twice each year in the spring or early summer and in the fall. The inspectors visit the nurseries at time of packing but are not present at any one nursery throughout the season.

A serious outbreak of brown tails has been present in the Loire district for the past three years. An attempt has been made to clean up orchards in the vicinity of nurseries, by the removal of winter webs, and no old nests were actually seen in the nurseries themselves. Last year the Department paid out thirty thousand francs for the collection of winter

webs, five francs per thousand was the amount first allowed, but this was later reduced by one half. Owners are required to remove the nests from their property and many prosecutions followed cases of neglect. The outbreak was first noted in the environs of Paris, stripping of oaks, hawthorns, and elms were plainly visible from the train and even the hedges along the railroad were defoliated.

CHAIRMAN RUGGLES: The next paper is by S. B. Fracker.

THE LEGAL ASPECTS OF PEST CONTROL

By S. B. FRACKER, *Madison, Wisconsin*

Up to within the last few years the only pests receiving legal attention were those we did not have and did not want. Little or no consideration was given to established insects altho they are causing 99% of the total losses. Research and education require no enactments by legislative authority, and extension activities constituted the only means of making entomology really "economic." For until the facts discovered by research are used in actual practice, science cannot be called "applied."

The great weakness of pest control so far is in connection with those species which should receive simultaneous attention over large areas. The Pacific Coast states have progressed much farther along these lines than other sections and have definitely recognized that pest control is a proper function of government. The ever-increasing losses from insects and plant diseases have now reached a point where they are of great public concern, and leaving the whole matter to the individual owner is no longer sufficient.

Kansas has recognized this in the case of grasshopper outbreaks and has passed a special statute providing for county and township grasshopper campaigns. In considering the organization of similar control work against the same insects in Wisconsin two years ago, the writer investigated the whole question of the legal status of pest control in the various states, and was surprised to discover that in most cases it had not gone beyond the stage of nursery inspection.

The statutes required in the case of firmly established insects are of a different type from the mandatory regulations governing nursery inspection, and quarantine orders. The need is for political machinery to handle funds, buy material, and supervise the mixing of sprays and poison baits. In the case of grasshoppers, for example, town or county board members are the logical local officials to buy poisons and attractive baits for distribution. This is much more satisfactory than to leave

the whole matter to the individual farmer, who is helpless unless the local stores voluntarily stock the needed materials. Such an arrangement, in effect, makes the town board both the pest control organization of the locality and a clearing house for information regarding the prevalence and control of injurious insects and plant diseases.

Usually the powers of local officers are closely restricted by state laws. In Wisconsin we found that new legislation was essential to enable towns and counties to make appropriations for such purposes, and to buy and sell the necessary supplies. At the same time it appeared to be as unreasonable to ask the passage of a new law regarding each specific insect pest or plant disease as it would be to provide a special statute for each human ailment. California has followed both policies. In addition to organizing a horticultural commission (now in the department of agriculture) with wide powers and extensive authority, the legislature has passed a series of special statutes on such subjects as the walnut codling moth, date palm scale, and Phylloxera. Many states, when faced with the barberry eradication problem enacted special barberry laws and whenever a new problem in the control of a disease with alternate hosts comes up under such conditions, a new legislative enactment will be necessary.

The solution adopted in Wisconsin was the passage of a bill providing authority for county boards, town meetings, town boards, and village boards to make appropriations for the control of insect pests, weeds, or plant or animal diseases. Advantage was taken of this opportunity immediately after passage of the bill, and county and town appropriations have since been made for grasshopper control, cattle tuberculosis, and apiary inspection. Action by town and county boards, it was felt should not be made mandatory under our conditions altho this may be necessary in the grasshopper infested regions of the great plains.

An additional clause required the state department of agriculture to provide technical assistance and direction in the expenditure of such funds, the purpose of this being to unify the work and prevent the waste of county and town resources. The form of organization is thus similar to that of public health work, very elastic but possessing full authority and the administrative machinery to cope with varied situations.

If we will then divide pest control problems into three classes from the standpoint of public interest, the requirements of an inclusive pest control program become apparent. First come those insects or diseases which threaten a locality but have not yet reached it; second, new arrivals whose distribution is spotted; third, native, or strongly established introduced forms, calling for repressive measures rather than extermination.

For preventing the introduction of outside insect pests and plant diseases, every state except three, has one or more quarantine regulations. In some cases statutory authority for the establishment of such measures seems to be weak or wanting and in others must be construed from a phrase which grants power to make regulations for the administration of nursery inspection. But in 45 states such orders have at least been "promulgated" by the powers that be.

Retarding the dissemination of localized pests is a similar problem for which more specific authority is usually granted. Nursery inspection regulations are in this class. One might mention here a favorite phrase of the lawmakers of the gulf states contained in several statutes of this group of commonwealths: "The department is authorized to make such rules and regulations, and *to do and perform such acts*, as may be needed to prevent the introduction and dissemination of insect pests and plant diseases."

To summarize, our pest control statutes should provide:

1. For the organization of a plant inspection and pest control office or department.

2. The usual administrative powers: access to premises, examination of possibly infested material; and enforcement of treatment or destruction when needed.

3. Specific authority to regulate the introduction and transportation of material either infected, exposed to infection, or from infected or infested areas within or without the state.

4. Authority to prohibit the introduction, transportation or harboring of plants whose damage consists in their being the alternate hosts of diseases already present, such as barberry bushes in grain growing regions, and Ribes in the white pine forests.

5. A form of organization for the local control of permanently established pests thru local civil officers or special horticultural or agricultural authorities, and the power to make local appropriations for these purposes. Such action need not be made mandatory on local officers unless it is demanded by their constituents, or in case their neglect would result in loss to other localities.

MR. BIGGAR: By whom are those inspectors appointed?

MR. FRACKER: The different states vary a great deal. It is becoming rare, perhaps, to have a nursery inspector a direct appointee of the governor. In many cases a Commissioner of Agriculture is appointed by the governor, and the nursery inspector is appointed by him.

MR. BIGGAR: Is he appointed for a definite period?

MR. FRACKER: I do not know of any state in which the nursery inspector is appointed for any specific period.

CHAIRMAN RUGGLES: The next paper is by T. J. Headlee.

PRESENT STATUS OF THE GIPSY MOTH IN NEW JERSEY[1]

By THOMAS J HEADLEE, PH.D., *State Entomologist, New Brunswick, N. J.*

The speaker can offer as his only excuse for presenting this paper the fact that the attempt to exterminate the present gipsy moth infestation in New Jersey constitutes one of the largest efforts of this kind that has ever been carried out within the limits of the United States. He has attempted to put himself in the place of an entomologist, whose field of endeavor lies in a state far removed from gipsy moth infestation, and to see whether he would, under those conditions, like to know how things are coming on in the effort now being made in New Jersey. It is on the basis of the answer to this question that he has felt that a statement of the situation might meet the wishes of the entomologists here assembled today.

At the close of the dormant season of 1920-1921 the one hundred square mile area reported in the paper entitled "The present status of the gypsy moth in New Jersey" and read before the last annual meeting of this association, had expanded to an area of approximately four hundred and ten square miles. Since that time, although the scouting has gone on through the fall and early winter and has covered approximately 38 percent of the original four hundred and ten square mile area, plus its four hundred and ninety square mile safety border, only one additional township has been found infested, and it can be said that with our present knowledge the area (410 square miles) known last spring has not been materially increased by the scouting.

The work against the gipsy moth up to July 1, 1921 had cost $254,-000.00, out of which about $82,000.00 was expended for a more or less permanent equipment of spraying machinery and hose. Of this sum the state of New Jersey furnished $112,000.00, Mr. J. B. Duke $25,000.00 and the United States Government $117,000.00.

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[1]For the information of persons who may not be familiar with a paper of the same title read before the Annual Meeting in the year 1920-1921, the writer desires to say that the gipsy moth fighting force in New Jersey is officered by experienced gipsy moth men drawn from New England, that Mr. H. A. Ames is in immediate charge of the work in New Jersey but that his work is done under the direction of Mr. H. L. McIntyre, who is in charge of the field work against the gipsy moth throughout the United States.

TABLE SHOWING EGG MASSES FOUND IN 1920-1921 AND IN 1921-1922

General Area

Place	1920-1921	1921-1922
Dukes Park, 1100 acres	3,000,000	51
Plainfield City	4 & 1 ♀ p.	0
Sayreville Township	4 & 2 ♀ p.	0
Westfield Township	1 ♀ p.	0
Balance of the general area	1405 & 106 ♀ p.	?
	Outside Areas	
Deal Beach	201	0
Elizabeth	1	0
Glen Rock or Ridgewood	2 & 1 ♀ p.	?
Madison	2	?
Mendham	1486	10
Paterson	1 ♀p.	?
South Orange	12	0
Wyckoff	4	?

From the above table, as far as the scouting of this fall and early winter has gone within the infested areas, it seems that there has been a very material reduction in the number of egg masses. What the continuance and completion of the 1921-1922 scouting will show is, of course, impossible to say; but if we may take the above figures as an indication, it is to be expected that the first year's work against the gipsy moth will show most excellent results. With one exception, that of Mendham, the outside areas thus far scouted have shown a complete disappearance of the insect.

The total cost of the work in New Jersey for the present year is not apt to be much less than it was last year, because the money which was expended last year in permanent spraying equipment and which this year will not need to be replaced will be taken up in the amount of additional scouting necessary. The work of the present year is supported by $125,000.00 state appropriation. The amount of money which the Government will be able to expend in New Jersey is still a matter of doubt, because the $400,000.00 appropriated by the last Congress for the gipsy moth work in the country is insufficient and of the $600,000.00 requested of Congress for the gipsy moth work for the coming fiscal year $100,000.00 is requested as immediately available. If the $600,000.00 request is granted, the New Jersey problem will probably receive a

minimum of $100,000.00 of Government Funds. The amount of private funds available for the present year is at present uncertain and cannot be reported on.

All things considered it is felt that an excelllent start in the direction of extermination has been made.

CHAIRMAN RUGGLES: We have one paper this morning that is not on the program. I am sure you will be glad to hear from Mr. Borodin who has a message from Russia and we will allow him a few minutes.

THE PRESENT STATUS OF ENTOMOLOGY AND ENTOMOLOGISTS IN RUSSIA

By D. N. BORODIN

American Entomologists have been in close contact with the Russian Colleagues until 1915, but since that time relations have not been reestablished. However, in spite of the Chinese Wall surrounding Russia, some news from there is reaching this country.

From a series of letters, which have been received, one may get some idea as to what has become of the Russian Entomologists and in what direction the work is now being carried on. First of all, it will be necessary to present a long list of those Russian workers, who died during the War, revolutions and famine. The majority of American colleagues are undoubtedly familar with the article by Mr. Y. A. G. Rehn, which appeared in the "Entomological News," Vol. XXXII, No. 7, July 1921 and entitled "An Appeal from Russian Fellow Entomologists." It may be well, however, to repeat this list here, supplementing it by a number of additional names.

Adelung, N.	(23. XI. 17)
Alferaki, C. N.	(24. VII. 18)
Bianki, V. L.	(10. I. 20)
Blecker, G. F.	(II. 19)
Bostanjoglo, V. N.	(1919)
Vakoolovsky, N. N.	(1918)
Vassiliev, E. M.	(VII. 19)
Zaroodni, N. A.	(13. III. 19)
Kavrigin, V. N.	(I. I. 19)
Karavaev, B. A.	(1919)
Kroolikovsky, A. K.	(X. 20)
Koordiumov, N. V.	(7. IX. 17)
Meinhard, A. A.	(24. VI. 17)
Oshanin, V. F.	(26. I. 17)
Porchinsky, J. A.	(8. V. 16)

Pylnov, E. V.	(1920.)
Rodzianko, V. N.	(1919)
Romanov, N. M.	(29. I. 19)
Selovsky, M. N.	(1921)
Semonov-Tian-Shansky, R. D.	(27. XI. 19)
Silantiev, A. A.	(21. III. 18)
Smirnov, D. A.	(17. VIII. 20)
Sonotzko, A. A.	(I. IV. 19)
Soovorov, G. L.	(29. IV. 18)
Fisher, E. N.	(1919)
Schreiner, A. E.	(VII. 18.)
Scherbakov, E. S.	(IX. 20)
Kholodkovsky, N. A.	(2. IV. 21.)
Shevyrev, I. J.	(7. VII. 10)
Jacobson, A. T.	(20. VI. 19)
Jacobson, A. A.	(12. XII. 18)

The cause of death of the majority of these Scientists is practically unknown. D. A. Smirnov, A. A. Sonotzko, A. T. Jacobson, and E. V. Pylnov died of spotted typhus fever; I. J. Shevyrev from starvation and N. A. Kholodkovsky from sarcoma cerelrostinae. Out of the total number of members of the Russian Entomological Society, fifty members perished during the period from 1916-1921. Many of the American colleagues will find in this list a number of very familiar names.

Systematic Entomology

Systematic Entomology in Russia was concentrated in Universities and Museums and to a great extent also had amateurs amongst its representatives.

Little is known so far in regard to the progress of this branch of Entomology in Russia and only limited information is on hand relative to some Entomologists:

G. G. Jacobson, Specialist on Coleoptera and Termitae, author of the voluminous, but not as yet completed work, "Coleoptera of Russia and Western Europe," and a comprehensive book, "Orthoptera and Pseudoneuroptera of Russia", is at the present time Secretary of the Entomological Society at Petrograd and works as before in the Zoological Museum of the Academy of Science at Petrograd.

Among other Entomologists working in this Museum are:

A. A. Mordvilko, a well known specialist in Aphididae;

A. N. Kirichenko, specialist in Rhynchota.[1]

A. A. Semenov-Tian-Shansky, specialist in Coleoptera, Hymenoptera and genus Forficula.

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[1]Who is continuing the work of the late V. F. Oshanin.

N. J. Kuznetzov, specialist in Lepidoptera; other Entomologists are also engaged at the Zoological Museum of the Academy of Science.

All these scientists may be addressed: c/o Zoological Museum, Academy of Science, Petrograd, Russia, Via England.

Although completely segregated from the entire scientific world during the last years, they are, nevertheless, continuing the work in these special lines insofar as the conditions of life permit to do so. There were no complaints in the letters received so far as to the hardships and deprivations, but there are constant requests to send separates, journals and books, which they are unable to secure under the present circumstances and a desire to learn whatever new has been discovered and published in the recent years by the men of science abroad.

Entomological Organizations

Among the new Entomological organizations opened in Russia, the following may be mentioned:

The old Bureau of Entomology of the Agricultural Scientific Committee of the Department of Agriculture, formerly in charge of the late J. A. Porchinsky, has been preserved and Dr. V. A. Pospielov is at the head of it now.

Several other Entomological Institutes were opened.

The first joint Congress of Entomologists and Phytopathologists took place in 1918, the second in October 1920, and the third was expected to be in October 1921. It was decided in the first and second Congresses to create joint Entomologo-Phytopathological Institutions, so-called "Stations of Plant Protection," associated with the Experiment Stations.

The new "Stations of Plant Protection" in Russia are as follows:

1. At Petrograd, Chief N. N. Bogdanov-Katkov; collaborators: Prof. M. N. Rimsky-Korsakov (specialist in Hymenoptera, genus Isosoma, Aphanura, genus Embia,) also, A. S. Skorikov (Specialist in Hymenoptera, genus Bombus).

   Address: c/o "Station of Plant Protection" (Stantzia Zaschity Rastenii) Petrograd, Russia. Via England.
2. At Ivanovo-Vosnessensk
3. At Cherepovetz
4. At Tambov
5. At Omsk (chief: Mr. Antonov)
6. At Tomsk (chief: Mr. Valov)
7. At Barnaul (chief : Mr. Jurin)
8. At Semipalatinsk (chief: Mr. Hoffman); also in other cities.

All Stations of Plant Protection are united under the Central "Division for Plant Protection" at the People's Commissariat of Agriculture, so-called "Ozra, Narkomzem," which is in charge of A. P. Adrianov, (formerly Chief of the Entomological Bureau of Kaluga).

Preparation of Specialists in Applied Entomology

Two or three special courses were organized at the Universities and Agricultural Colleges of Petrograd and Moscow for training specialists in Applied Entomology. Definite information has been received in regard to such courses at the Petrovsko-Razumovskoye Agricultural Academy (near Moscow) and also at Petrograd.

The course of Entomology is being taught in three sections:

1. Forest Entomology
2. Orchard and Garden Entomology
3. Field Entomology

The lectures in these courses are given by Prof. V. F. Boldyrev, specialist in Biology of Orthoptera, who is assisted by Mr. A. P. Andrianov.[1]

Applied Entomology presents perhaps the best example of what self-denying workers can accomplish along the lines of organization in spite of unfavorable living circumstances.

Publications

We have only a small list of Entomological publications issued during the recent years, but we know that a number of books, reports and a great many popular booklets (pamphlets) of the type of farmers' bulletins in this country have been published to answer the demand of practical needs, which the author of this report has at his disposal.[2]

New Methods of Insect Control

New methods of combating injurious insects presents the application of asphyxiating gases, which were left after the War. These are being used for the destruction of the Asiatic Locust (*Locusta migratoria*) in the deltas of large rivers, such as Volga, covered by thick vegetation consisting of an impassable growth of cane (*Scirpus lacustris*) and inaccessable for the ordinary spraying operations by means of a horse power pump or knapsack sprayer. In such places gases were used with great success. The same substances were used also for the destruction

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[1]The Medical and Veterinary Entomology is concentrated in Colleges and Universities.

[2]Reference of the most important editions issued during the last few years in Russia is printed in the "Review of Applied Entomology," in London.

of Locusts and at the same time Rodentia of the genus Spermophilus, which are abundant in the steppes of South-Eastern Russia.

New poisoned Siberian mixtures are now in use throughout all Siberia.

Summary

1. The work of Entomologists in Russia is being continued in spite of the isolation of that country.
2. Many well known and celebrated Entomologists are participating in this work.
3. They are in great need of scientific Entomological literature published abroad during the years 1915-1921, that is, of books, journals, separates, etc. which they are unable to purchase under existing conditions, but for which they would send in exchange Russian publications.
4. The U. S. Post Offices accept mail for Russia, addressed via England; letters reach Russia without very much delay.
5. Mail from Russia to the the United States is not arriving satisfactorily, but somewhat better at this time.
6. The writer of this report, who represents one of the divisions of the Russian Agricultural Scientific Committee will be glad to impart any information he receives regarding Russian Entomologists upon request from his American colleagues and will also accept for forwarding to Russia any parcels with literature, if such would be found possible to spare for this purpose. It may be directed to the following address: 110 W. 40th St., Room 1603, New York City.

Chairman Ruggles: We are all much interested in the entomological problems of Russia, but unfortunately, time will not permit us to discuss them. We now have some business to attend to. The first in order will be the nomination of the Chairman and the Secretary for the Horticultural Inspection Section for next year.

Messrs. Harned and Sasscer were nominated for Chairman and Secretary respectively, and duly elected.

Chairman Ruggles: Is there any other business?

Mr. Sasscer: I mentioned a moment ago that Mr. J. J. Davis had prepared a very complete and excellent index of the greenhouse insects. So far as I am aware, this is the only manuscript of the kind, and unfortunately, it has not been published although it has been ready for publication for several years. Apparently there is some difficulty in getting some organization to accept it. Inasmuch as we all are,

or should be, interested in greenhouse insects, and all naturally would like to have a ready reference, I move that the Resolutions Committee of the parent association be urged to incorporate in their resolutions a request suggesting that the Society of American Florists publish this paper.

The motion was seconded and carried.

CHAIRMAN RUGGLES: Is there further business?

On the committee to draw up recommendations with reference to greenhouse material, besides Mr. Sasscer, I will appoint H. F. Dietz, T. J. Headlee, Franklin Sherman, Jr., and G. M. List.

If there is no further business, we will stand adjourned.

Adjournment.

NEW EUROPEAN BEE DISEASE THREATENS BEEKEEPING IN AMERICA

Serious ravages causing almost complete destruction of the beekeeping industry in portions of Europe by the "Isle of Wight" disease has started determined action by American beekeepers to save their business from similar losses.

"Isle of Wight" disease is caused by a parasitic mite in adult bees and is easily transported by bees shipped from Europe to America as was proved during the past summer when live bees carrying living mites arrived in Washington from Scotland. Should this disease become established in America, beekeepers, queen breeders and manufacturers of bee supplies would quickly be ruined and horticultural interests would be seriously damaged.

A meeting was called at the Bee Culture Laboratory in charge of Dr. E. F. Phillips of the Bureau of Entomology at Washington, D. C., March 9, which was attended by specialists from several states and Canada who are interested in measures to prevent the introduction of the Isle of Wight disease into the United States and Canada.

Among those at the meeting were Dr. L. O. Howard and Dr. C. L. Marlatt, Chief and Assistant Chief of the U. S. Bureau of Entomology, Dr. E. F. Phillips, Government Apiarist, Prof. F. E. Millen, Apiary Inspector for Ontario.. Canada; Prof. Geo. H. Rea, Pennsylvania State College; E. G. Carr, Apiary Inspector of New Jersey, J. G. Sanders, Harrisburg, Pa., President of the American Association of Economic Entomologists, Prof. N. E. Phillips, Mass. Agric. College, and Dr. H. E. Ewing, Expert on Mites, of U. S. Bureau of Entomology.

The meeting decided to recommend that the U. S. Post Office Department shall at once prohibit the introduction of queen bees through the mails from all foreign countries except Canada, and that a bill be introduced into Congress to prohibit the introduction of adult bees into the United States except for experimental and scientific purposes by the U. S. Department of Agriculture. Since there is no known Isle of Wight disease in Canada, and since it is hoped and expected that the Dominion of Canada will establish the same safeguards to the beekeeping industry, it is planned not to establish any quarantines or prohibitions against shipments of bees from and to Canada.

It was the opinion of all those in attendance that the Isle of Wight disease is such a serious menace to beekeeping on this continent, that every possible step should be taken to prevent its introduction, and that all importations of queenbees should be stopped. Pending full legislation in this matter, it is hoped that beekeepers throughout the continent will cooperate to the fullest degree by making no attempts to introduce adult bees into the country. Any queen breeder who introduced this disease into the country would be doing a great damage to the beekeeping industry, and it would be a serious drawback to his future business.

The committee urges that beekeepers who see any outbreak of any disease of adult bees shall at once send samples for examination and diagnosis to the Bureau of Entomology, Washington, D. C. More detailed information concerning this disease will be presented in a future issue of this journal, and in the meantime information may be obtained by writing to the Department of Agriculture, Washington, D. C., for a copy of Department Circular 218, entitled "The Occurrence of Diseases of Adult Bees" for free distribution.

J. G. Sanders, Harrisburg, Pa., Chairman
E. G. Carr, New Jersey.
F. Eric Millen, Guelph, Canada.
Committee.

The Paradichlorobezine Treatment. The control of the California peach borer, *Aegeria opalescens* Hy. Edw. was successful in the counties of Alameda, Santa Clara and San Benito last fall where it was used chiefly on apricot trees. The problem of rootstocks is a new one which must be considered in this state, but as yet no injury has resulted to the ones treated.

An infestation of the pear root aphis, *Eriosoma languinosa* Hartig was completely controlled by the method with no apparent injury to 4 year old pear trees on French roots. The latter experiment is being rapidly enlarged with very interesting results.

E. O. Essig

Scientific Notes

Crop Protection Institute Fellowships. In order to promote original research relative to the fungicidal and insecticidal properties of sulphur and the effects of sunlight, temperature and moisture on its action, the Crop Protection Institute expects to offer two fellowships yielding an income of $2500.00 each. Training in chemistry and plant physiology is a prerequisite, and candidates should have demonstrated ability to undertake research efforts of a high type. Applications, accompanied by reprints of scientific articles and letters of recommendations, should be made immediately to the Crop Protection Institute, National Research Council, Washington, D. C. A statement explaining the purposes and scope of the projects and selection of research laboratory may be obtained on application.

W. C. O'Kane,
Chairman
Paul Moore,
Secretary

Unusual Infestation of Bulb Mite in Greenhouse. Complaints were received by the Pa. Bureau of Plant Industry from a florist at Malvern, Pa. that a heavy infestation of earthworms was causing great damage to beds of Smilax (*Asparagus medeoloides*) and "asparagus fern" (*Asparagus plumosus*) in his greenhouse during the present season. Samples of plants examined showed a much-stunted condition of the roots and a soft rot of the tubers with lesions which penetrated the outer skin into the tender tissues of the apparently healthy roots. Sciarid larvae were present, but close examination with the binoculars revealed the presence of numbers of large, palecolored, sluggish mites, particularly about the crown of the plants, where they were found in largest numbers by parting the fibers of the half decayed roots. Cavities in healthy roots which were hardly visible to the unaided eye were found in most instances to contain several of these mites, apparently feeding on healthy tissues. From balsam mounts made of specimens collected they were determined by Dr. H. E. Ewing of the U. S. National Museum as *Rhizoglyphus* sp., apparently *hyacinthi* Boisd.

In that this mite has not been recorded as a pest of these hosts and that it is very generally distributed in this greenhouse, causing a large reduction in the season's cut, its possibilities as an important pest should not be overlooked.

J. K. Primm,
Oak Lane, Pa

Notes on Orchestes rufipes. The work of this insect has been under my more or less superficial observation near Salt Lake City, Utah, since 1914. However it was only late in the fall of 1920 that I observed the adults issuing from mines in willow leaves and completely devouring the green substance of infested willows.

As soon as the leaves appeared on the same willows in the spring I found the adult beetles destroying the young leaves and mating. Once a month during the summer I have made notes in the same locality and found the adults always feeding and mating. The attack was confined to *Salix fendleriana* and *Populus angustifolia*. Early in the summer dark blotches appeared on the willow leaves suggesting that larvae were at work. The poplar leaves were not similarly blotched and there were no larvae in the willow blotches. Apparently the discolored area surrounding feeding punctures was due to bacterial infection.

Upon making an observation on the 30th of September I found the willow leaves over quite a large area practically all killed and blackened. Adult beetles solidly covered the under surfaces of the remaining green leaves. They were also attacking the poplar, the narrow leaved willow, *Salix exigua*, a third species of willow, *Salix schouleriana*, and a birch, *Betula fontinalis*. From the mines in the willow leaves I was able to obtain only adult beetles, apparently on the point of emerging, and certain parasites. From the poplar leaves I obtained several larvae, pupae and parasites.

There seems to have been a decided increase in the severity of the attack since the first observations were made and the colony seems to be growing very rapidly.

WYATT W. JONES
Salt Lake City, Utah

On the extra instar of the Chinch bug. Subsequent to the appearance of my paper entitled "Bionomics of the Chinch bug" Bul. 1016, I have learned that the extra instar of this insect was previously discovered by Dr. Yuasa of the University of Ill. and was made note of in the *Ent. News* (Vol. 29, pp. 233-234, 1918). It is needless to say had the writer known of Dr. Yuasa's discovery at the time the paper was written that gentleman would have been given full credit.

PHILIP LUGINBILL,
U. S. Bureau of Entomology, Washington, D. C.

Destructive Bark-Beetles in the Monterey Pine Forests. During the last few years, the Del Monte Properties Company which controls most of the pine forests in the vicinity of Pebble Beach, California, has been thinning out the grove. Unfortunately most of the felled timber was allowed to remain in the forest, either as corded wood, poles or trash, with the result that various species of bark beetles were able to develop to an enormous extent. Last year the cutting stopped and in consequence the beetles overlapped into the standing timber, causing a great deal of damage. The red turpentine beetle, *Dendroctonus valens* Lec. was responsible for the death of a few of the larger trees but most of the damage was done by *Ips plastographus* Lec. and *Ips radiatae* Hopk. with one of the species of *Pityophothrus* causing the death of a few of the smaller trees. The company now has a large force of men at work cleaning up the area so that future damage will no doubt be minimized.

EDWIN C. VAN DYKE

Zoological Record. Owing to the collapse of the International Catalogue of Scientific Literature in connection with which the *Record* was published from 1906 to 1914, the Zoological Society of London has undertaken to bear the whole financial responsibility for the preparation and printing of the *Record*.

Owing to the great increase of the cost of printing and to the very meagre support accorded to the *Record* by Zoologists and Zoological Institutes generally, the financial burden of this undertaking on the Zoological Society is becoming very severe. The cost of printing the *Record* now amounts to between £1500 and £2000 annually and the Society receives back by Subscribers and sales less than 25% of this sum; I fear therefore, unless Zoologists are prepared to make greater efforts to support the undertaking there is a strong possibility that the Council of the Zoological Society may refuse to find this large sum each year.

It appears therefore to be the duty of every Zoologist to help so far as he is able to support this most invaluable work. All particulars and forms of subscription can be obtained from the Secretary of the Zoological Society, Regents Park, London, N. W. 8. It may be mentioned that the price of the whole volume is now £2.10.0. and the price of the separate parts a proportional smaller sum; that of the portion Insecta is 15/—.

V. S. SCLATER
Editor *Zoological Record*

The European Red Mite In California. The so-called citrus red spider, *Tetranychus citri* Mc Gregor (*T. mytilaspidis* Riley), which occurs abundantly in the citrus orchards of Southern California and in the deciduous fruit orchards of California, Oregon and Idaho proves to be the European red mite, *Paratetranychus pilosus* C. & F., recently reported from Connecticut by Dr. Philip Garman. The western species has been submitted to Dr. Philip Garman, Dr. H. E. Ewing and others and there seems to be little doubt in the conclusions reached by the best authorities on the subject.

In the deciduous fruit orchards of the West this mite bids fair to be as serious as it is in the citrus orchards.

It probably has a very wide distribution throughout the United States because of the ease of carrying the eggs on nursery trees. The small round red eggs are decidedly flattened, minutely striated and usually furnished with a small stalk so admirably illustrated on page 357, Vol. 14, No. 4, JOURNAL OF ECONOMIC ENTOMOLOGY, Aug. 1921, by Dr. Garman.

E. O. ESSIG

The Miller Memorial Beekeeping Library. The death of Dr. C. C. Miller of Marengo, Illinois, made a gap in the beekeeping ranks in the United States and throughout the world which will be hard to fill. With his high ability as a beekeeper, Doctor Miller possessed such rare qualities as a man that he was revered by beekeepers as few if any have been. On his death there were many suggestions of ways to honor his memory, and a volunteer committee of five has undertaken this. It was thought best not to undertake anything which would involve the raising of a large sum. The committee has decided to raise whatever could be obtained without too great sacrifice and to establish a permanent endowment for a library of beekeeping in some one of the leading colleges or universities in which beekeeping is taught, to supplement the library purchases of the college itself. Such a memorial will in a sense go on doing what Doctor Miller did so well during his life, namely to be of help to beekeeping. It is greatly to be preferred to a pile of granite as a memorial fitting to a man of his type.

Since there is as yet no library in the country in which there is sufficient of the beekeeping literature to be fully helpful to the investigator, the establishment of such a library will be an important addition to our facilities, wherever it may be established. The purpose of this note is frankly to enlist the support of entomologists in this movement, and to suggest that many will wish to add something to the fund. Contributions of any size will be gratefully received, and should be sent to the chairman of the committee, Mr. C. P. Dadant, Hamilton, Illinois.

E. F. PHILLIPS,
Bureau of Entomology, Washington, D. C.

Mealy Bug Control on Pear Trees. A considerable amount of work is being done on the control of Baker's mealy bug, *Pseudococcus maritimus* Ehrh., which in some orchards is a serious pest of pear trees, of which the Winter Nellis is most injured, although other varieties are also attacked. During the dormant season the mealy bugs and egg masses occur in quantities in crevices and under the rough bark and on the undersides of the smaller limbs.

After first scraping away much of the loose bark on the trunks and bases of the main limbs, the trees are thoroughly sprayed with miscible oil or crude carbolic acid and distillate emulsion. The latter is no better than the miscible oil, but when prepared at home is very much cheaper. The formula recommended is as follows

Stock Solution

Whale oil soap	40 pounds
Crude Carbolic acid (25%)	5 gallons
Distillate (28 Baume)	10 gallons
Water to make	50 gallons

First dissolve soap in 10 to 15 gallons of hot water; add crude carbolic acid and distillate and remainder of water. Boil 20 minutes. For use dilute one part of above to 20 parts of water.

In cases of serious infestation three applications are being made during January and February.

E. O. Essig

Curly Leaf Transmission Experiments with Beet Leafhopper (*Eutettix tenella* Baker), Summary.

The beet leafhopper when it hatches from the egg is non-infective.

Curly leaf is not transmitted through the seeds from "stechlinge" affected with the disease before and after transplanting.

We have failed to demonstrate up to the present time that the beet leafhopper is a mechanical carrier of curly leaf, or a mechanical carrier in mass infection of a beet.

The minimum incubation period of the infective principle of curly leaf in the beet leafhopper required four hours at the following temperatures: maximum 103° F.; minimum 94° F. and mean 100° F. and three days in the sugar beet at the following temperatures; maximum 103° F.; minimum 57.7° F. and mean 80.3° F.

Beet leafhoppers which had been fasted and then the mouth parts contaminated with *Bacillus morulans* isolated from curly leaf beets or when allowed to puncture the bacteria into the tissue, rubbed on a portion of a beet leaf, failed to transmit the disease.

Daily inoculations of juice from beets, upon which infective beet leafhoppers had fed from 1-8 days or until the earliest symptom of curly leaf appeared, failed to produce the disease in healthy beets. Juice exuding from curly leaf beets in the field when incoluated into healthy beets also gave negative results. The excrement of infective beet leafhoppers inoculated into the petioles of healthy beets failed to produce curly leaf. The disease did not develop when healthy leaves were rubbed with crushed curly leaf foliage. We have failed to obtain a single case of curly leaf up to present time by inoculating various internal organs from infective beet leafhoppers vivisected in physiological salt solution (.8% normal) and in sap pressed from healthy beets.

Henry H. P. Severin, Ph.D.,
Calif. Agr. Exp. Station.

Anti-Mosquito Convention

The ninth annual meeting of the New Jersey Mosquito Extermination Association was held at the Hotel Chalfonte, Atlantic City, New Jersey, March 1-3, 1922. The meeting was well attended by mosquito control workers from New Jersey and various sections of the country. The meeting was called to order Wednesday March 1, at 8 P. M., by President Charles Lee Meyers of Jersey City. Mr. Meyer's opening address entitled "Industrial Results of Mosquito Control" brought out several points that are of great economic importance. Mr. Robert T. Engle of Beach Haven, President Ocean County Mosquito Commission read the next paper, "Resort Development as a Result of Mosquito Control."

The second session, March 2, 10:00 A. M., was given up to reading and discussing papers as follows—: "Effective and Practical Methods of Mosquito Control Work, by Russell W. Gies, Chief Inspector, Union Co., N. J.; "The Need For, The Method of Carrying On, and The Results of Locally Supported Campaigns," by Jesse B. Leslie, Chief Inspector, Bergen Co., N. J.; "Women's Part in Mosquito Control Work," by Mrs. Peter C. Olsen, President Womens Club, Perth Amboy, N. J.; "The Problem of Evaluating Mosquito Density and the Advantages to be Gained from Its Solution," by Dr. Thomas J. Headlee, State Entomologist, New Brunswick.

Third session, Thursday, March 2, 2:00 P. M. Mr. Joseph A. LePrince, Senior Sanitary Engineer, U. S. Public Health Service, gave an interesting talk on "Important Phases of Anti-Mosquito Work of the United States Public Health Service," followed by Dr. L. O. Howard, Chief Bureau of Entomology of the United States Department of Agriculture, "Recent Results in Anti-Mosquito Work of the Bureau of Entomology, Featuring Results of Experiments Carried on at Mound, La." A recently produced motion picture of great educational value, entitled "Warfare Against the Mosquitos of New Jersey," was shown at the conclusion of this session.

At the fourth session, Thursday March 2, 8:00 P. M., Mr. Peter H. Woodford, General Passenger Agent, Long Island Railroad Company, delivered an address entitled "Need For, The Solution of the Problem, and the Hoped For Results of Mosquito Control." The rest of the session was given up to the reading of papers, as follows:—"Recent Developments in Mosquito Control Work in Greater New York," by Eugene Winship, Department of Health, City of New York; "Connecticut," by Samuel T. Sealy, Connecticut Agriculture Experiment Station, New Haven, Conn.; "Nassau County, N. Y., " by William H. DeMott, Chief Inspector.

At the fifth session, Friday March 3, 10:00 A.M., papers entitled: "Presentations of New and Unusual Features of County Mosquito Control Work in 1921," were presented by the representatives of the active mosquito commissions in New Jersey, as follows:—Atlantic County by Fred A. Riely, Superintendent; Bergen County by Dr. Lewis W. Brown, Commissioner; Cape May County by William Porter, Commissioner; Essex County by James E. Brooks, Consulting Engineer; Hudson County by Lewis E. Jackson, Executive Secretary; Middlesex County by Lewis E. Porter, Commissioner; Monmouth County by Dr. G. Van Voris Warner, Treasurer; Ocean County by Dr. Frank P. Brouwer, Commissioner; Passaic County by Walter R. Hudson, Commissioner; Union County by Dr. R. G. Savoye, Commissioner; followed by "Summary of County Work" by Wilbur M. Walden, Assistant Entomologist, New Jersey Agricultural Experiment Station, New Brunswick.

The following officers were elected for the ensuing year: President Wilfred A. Manchee, Newark; First Vice-President W. H. Randolph, Rahway, Second Vice-President Dr. Julius Way; Secretary T. J. Headlee, New Brunswick; Assistant Secretary, Wilbur M. Walden, New Brunswick; Treasurer Lewis E. Jackson, Jersey City.

S. T. Sealy

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

APRIL, 1922

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, provided that at least 100 reprints be ordered at full price rates; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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The imperious demands of war in recent years resulted in the laying hold of the exceedingly diversified knowledge classed as science, and its utilization for the advancement of specific purposes, most worthy, many tending very strongly in the opposite direction. The National Research Council has accomplished much in recent years in bringing the diverse or to a certain extent isolated sciences into fruitful relations one with the other to the mutual advantage of both and the very great gain of the nation as a whole. The leaven has been working gradually throughout the lump and many Entomologists have come within the sphere of beneficent action. First an organic connection was established between the Association and the Council. This was followed by the creation of a Crop Protection Institute, an organization designed especially to develop cooperative work along practical lines. The cooperative dusting projects of last year are a typical line of activity. A most important advance step has been taken in securing the recently announced cooperation of several sulphur companies in a fundamental study of the insecticidal and fungicidal properties of sulphur. These are new departures and may be regarded as significant of the trend of the times. We may expect in the near future more effective productive, cooperative or team work among scientists and there is a possibility of less emphasis being placed upon the work of the self-centered specialist with comparatively little appreciation of anything outside his important problem or problems.

Current Notes

Mr. Arthur Gibson, Dominion Entomologist of Canada, was ill for two weeks with bronchitis during the latter part of January.

Dr. W. E. Hinds, Alabama Agricultural Experiment Station, Auburn, Ala., visited the Bureau of Entomology during the latter part of February.

Professor Vernon L. Kellogg, who is now secretary of the National Research Council, has been elected a Trustee of the Rockefeller Foundation.

Professor W. C. O'Kane spoke before the New Haven members of the Appalachian Club of New Haven, on the evening of January 28.

The degree of Doctor of Philosophy was conferred on J. D. Tothil of the Canadian Entomological Branch, by Harvard University, early in February.

Mr. H. A. Gossard of the Ohio Station was ill from rheumatism the latter part of January, and was confined to his bed for several days.

Mr. George A. Maloney of the Boll Weevil Laboratory, Bureau of Entomology, delivered an address on boll weevil control before the Rhode Island Textile Manufacturers at Providence, on January 21.

Mr. R. Heber Howe, Jr., was recently the recipient of the degree of Master of Arts from Harvard University. He has also been appointed one of the coaches of the crew at Harvard.

Dr. E. P. Felt and Mr. A. F. Burgess were speakers at a tree protection institute, held at the Agricultural Experiment Station, New Haven, Conn., on February 21. About 70 were in attendance.

According to Official Record of the U. S. Department of Agriculture, Mr. George D. Smith of the Bureau of Entomology has resigned as entomological assistant to accept a position with the Florida Agricultural Experiment Station.

Mr. Quincy S. Lowry, Assistant Director of the Division of Plant Pest Control, Massachusetts Department of Agriculture, visited Washington, New York and New Haven on a brief vacation in March.

Mr. A. F. Burgess and Professor W. C. O'Kane addressed the eleventh annual meeting of the Massachusetts Tree Wardens and Foresters Association held in Horticultural Hall, Boston, March 8 and 9.

Mr. H. G. Crawford of the Canadian Entomological Branch, left Ottawa February 9, on annual leave, and expected to visit the European corn borer laboratory at Arlington, Mass., maintained by the U. S. Bureau of Entomology.

Mr. J. R. Douglass, scientific assistant of the Bureau of Entomology and assigned to the force of N. F. Howard, Birmingham, Ala., has resigned to take up vocational training in entomology at Cornell University, Ithaca, N. Y.

A new motion film showing details of the methods of controlling the boll weevil by dusting with calcium arsenate has recently been completed by the U. S. Department of Agriculture, and will be released shortly.

Mr. A. G. Dustan of the Canadian Entomological Branch, left the Fredericton, N. B. laboratory on January 7, to continue at MacDonald College his investigations on the diseases affecting the apple sucker and the green apple bug.

Prof. A. G. Ruggles, State Entomologist of Minnesota and Prof. W. H. Brittain, Provincial Entomologist of Nova Scotia, spent January 2, at headquarters at Ottawa, looking over the organization of the Branch and meeting members of the Staff.

According to the *Florida Entomologist*, Dr. H. S. Davis, professor of zoology, including entomology, University of Florida, and a charter member of the Florida Entomological Society, has resigned to accept a position in the U. S. Bureau of Fisheries.

Dr. A. L Quaintance of the Bureau of Entomology has returned from a trip to New Orleans, La., and Bentonville, Ark., where he conferred with men in charge of the Bureau's laboratories at these places regarding work under way.

Mr. O. I. Snapp of the Bureau of Entomology, gave addresses on peach insects before the Tennessee State Horticultural Society, at Nashville, Tenn., January 24-26, and the Association of Southern Agricultural Workers, at Atlanta, Ga., February 21-23.

Dr. L. O. Howard attended the ninth annual convention of the New Jersey Mosquito Extermination Association at Atlantic City, N. J., March 1 and 2, and gave an address on "Recent Results of the Anti-Mosquito Work of the Bureau of Entomology."

According to *Science*, Professor C. F. Curtis Riley of the department of zoology of the University of Manitoba, who is carrying on investigations on the ecology and behavior of the Hemipterous family Gerridae, has been elected a member of the Zoological Society of Tokyo, Japan.

Mr. E. H. Strickland has resigned from the Entomological Branch, Canadian Department of Agriculture, to accept a position as professor of entomology in the University of Alberta. Mr. Strickland joined the Branch in 1913 and returned to it after service over seas in 1919. His resignation takes effect March 31, 1922.

A conference on combating the Japanese beetle in New Jersey and Pennsylvania was held by the Bureau of Entomology February 21. Professor J. G. Sanders, Director of the Pennsylvania Bureau of Plant Industry, Harrisburg, Pa., Dr. T. J. Headlee, State Entomologist, New Brunswick, N. J., and C. H. Hadley, Riverton, N. J., were present.

According to *Science* leave of absence has been granted a party of naturalists from the State University of Iowa to spend the summer of 1922 in the Fiji Islands and New Zealand. Professor C. C. Nutting is zoologist, and will act as leader. Assistant Professor Dayton Stoner is entomologist and ornithologist and Mrs. Dayton Stoner is assistant entomologist.

Mr. George E. Sanders, who has been in charge of the insecticide investigations of the Entomological Branch, Canadian Department of Agrictulture, with headquarters at Annapolis Royal, N. S., resigned the latter part of January, to accept a position with the Dosch Chemical Company with headquarters at Louisville, Ky. Mr. Sanders has been connected with the Canadian entomological staff since 1910.

The following appointments have been announced by the Bureau of Entomology: Troy Thompson, temporary field assistant on the force of K. L. Cockerham, Biloxi, Miss., and has been stationed at Van Cleve, Miss., sweet potato weevil eradication; Otto D. Link, temporary field assistant, under B. L. Boyden, Daytona, Fla., and stationed at Macclenny, Fla., sweet potato weevil eradication; L. W. Brannon, D. M. Dowdell, Jr., and H. B. Lancaster, probationary appointments as junior entomologists.

The Rev. Thomas W. Fyles, D. C.L., F.L.S., of Canada, died August 9, 1921, at Ottawa, where he had resided since 1912. He lived at Levis for some twenty-five years, where he was employed by the Society for the Promotion of Christian Knowledge, as immigration chaplin. Dr. Fyles published many entomological papers in *Canadian Entomologist* and in the *Reports of the Ontario Entomological Society*, of which he was president from 1899 to 1901.

Mr. F. C. Bishopp of the Dallas, Tex., laboratory, Bureau of Entomology, following attendance at the Toronto meeting, visited several points in New York in connection with the ox-warble work being done in that State. Coming on to Washington he spent a few days conferring with various Department officials on phases of the work on investigations of insects injurious to animals. He then returned to Dallas, making a few stops *en route* to investigate ox-warble conditions.

According to *Science* Professor William M. Wheeler, dean of the Bussey Institution, Harvard University, will give a course of lectures at the Lowell Institute, Boston, on "Social Life Among Insects." Dates and subjects are as follows:—February 27, "A Comparison of Animals and Human Societies. The Social Beetles." March 2, "Wasps, Solitary and Social." March 6, "Bees, Solitary and Social." March 9, "Ants, their Development, Casts, Nesting, and Feeding Habits." March 13, "Parasitic Ants, and Ant Guests." March 16, "Termites, or White Ants."

Clarence F. Mickel of Lincoln, Nebraska has taken up his work at Minnesota as a graduate student and as assistant in economic entomology, His family will come later in the month after he has had time to locate living quarters. Mr. Mickel is a graduate of the University of Nebraska with the class of 1917. For two years he was extension entomologist at the University of Nebraska and after his return from war service he was research entomologist with the American Beet Sugar Company at Rocky Ford, Colorado.

Dr. Paul B. Lawson of the University of Kansas will again give the courses in Elementary Economic Entomology in the summer session of the University of Minnesota. At the close of the session Dr. Lawson will join Dr. H. B. Hungerford, Dr. H. H. Knight and Mr. W. E. Hoffman in an entomological field trip to the northern section of Minnesota. It is hoped that several other entomologists interested in this practically unworked fauna may join the party.

The annual conference of Hessian fly workers of the branch of Cereal and Forage Insect Investigations was held at Carlisle, Penn., on January 2. The following persons were in attendance: W. R. Walton and Joe S. Wade, Washington, D. C.; W. H. Larrimer and W. B. Cartwright, West Lafayette, Ind.; J. R. Horton, Wichita, Kans; A. F. Satterthwait, Webster Groves, Mo.; G. G. Ainslie, Knoxville, Tenn.; W. J. Phillips, Charlottesville, Va.; L. P. Rockwood, Forest Grove, Oreg; and P. R. Myers, C. C. Hill, and H. D. Smith, Carlisle, Penn. It was the unanimous opinion of those present that the conference had attained valuable results and that similar conferences should be held annually in the future.

The third general conference of the Entomological Branch Staff was held in Ottawa on January 3, 4, and 5. In addition to the officers stationed at Ottawa, the following were in attendance at the meetings: Mr. Sanders of Nova Scotia, Mr. Tothill of New Brunswick, Mr. Petch of Quebec, Messrs. Ross and Hudson of Ontario, Mr. Criddle of Manitoba, Messrs. Strickland and Seamans of Alberta, and Messrs. Hopping and Downes of British Columbia. The conference was opened by the Deputy Minister of Agriculture, Dr. J. H. Grisdale, who welcomed the outside men to Ottawa, and stated further that he hoped that as a result of the meetings, the Branch would be in a better position to formulate schemes for combating insect pests. Dr. Grisdale also attended several other sessions of the conference.

The brown-tail moth scouting work in the Providence of New Brunswick was completed the latter part of January and no winter nests of this insect were found. Up to January 28, 757 nests of the brown-tail moth were collected in Nova Scotia, the majority of these being found in the Bridgetown, Round Hill and Torbrook dis-

tricts. Local outbreaks have occurred at all the above localities within the past few years. Inspector Cameron examined the corn on exhibition at the Ottawa Fair on January 17 to 21. Owing to the large number of exhibits of corn on the cob at the Chatham Fair, Mr. W. L. Oliver of Port Stanley, Ont., was appointed to assist Mr. Hudson in this work. A total of 11,330 ears of corn were examined. All corn originating in the quarantined area was returned to that area at the close of the show.

A course of six lectures to be given in Chipman Hall, Tremont Temple, Boston, on Saturday afternoons at 2:30 o'clock has been arranged by the Cambridge Entomological Club. These lectures are to be illustrated with lantern slides and motion pictures, and the subjects, speakers and dates are as follows: February 18, L. O. Howard, Chief of the Bureau of Entomology, U. S. Department of Agriculture. On the work of the Bureau with special reference to the Gipsy Moth and other injurious insects, of local interest. February 25, Wm. T. M. Forbes of Cornell University, On some Habits of Wasps and their relatives. March 11, C. T. Brues, Professor of Entomology at Harvard University On Mosquitoes and other insects as carriers of disease. March 18, Miss Edith M. Patch, Entomologist of the Maine Agricultural Experiment Station. On the Seven Lives of an Elm Aphis, *Eriosoma lanigera.* March 25, J. H. Emerton, On the Spiders, their structure, habits and relations to Insects.

About February 1, 1922, Messrs. S. S. Crossman and Dr. John N. Summers of the gipsy and brown-tail moth investigations, Bureau of Entomology, left this country to take up parasitic work in Europe and Japan respectively, in continuation of work along this line which was interrupted by war conditins. Prior to the war, parasites from abroad were received in this country and were propagated and disseminated throughout the area infested with the gipsy and brown-tail moths. Many of the species imported were successfully established and it was purposed to continue the work of importing, studying and colonizing in the field all species of parasites which were found to aid in the control of the two pests in their native homes. The outbreak of the world war prevented a continuation of this effort. It is believed that much benefit will be derived from further work abroad in importing beneficial parasities to aid in control in this country. A number of species which were imported prior to the interruption of this work did not become established for various reasons, some of which are not well understood at this time. It seems certain that some of these species may be established if study is continued and earnest effort made through foreign work by scientists experienced in moth investigations in this country. M. Crossman will visit Portugal, Spain, Italy, Austria, Czecho-slovaka, France and Germany in an endeavor to supplement the information which we now have regarding the gipsy and brown-tail moths in their native homes, as well as the parasites which attack them. Dr. Summers will visit the localities in Japan which promise the greatest results.

Mr. Harry L. Parker, attached to the corn-borer investigations, Bureau of Entomology, formerly located at Arlington, Mass., sailed for France on January 17 for the purpose of assisting W. R. Thompson in the collection and shipment of parasites of the corn borer from France to the United States. Mr. Parker's address will be: European Parasite Laboratory, Domaine du Mort Fenouillet, Hyeres, Var, France.

The eighth annual meeting of entomological workers in Ohio Institutions was held February 3, 1922, in Room 109, Botany and Zoology Building, Ohio State University, Columbus, Ohio. The following program was presented: F. H. Krecker,

Emergence of a May-fly from its Nymphal Skin under Pelagic Conditions; A. E. Miller, Problem of a Collector; C. H. Waid, Observations on the Potato Leafhopper; T. H. Parks, Experiments and Demonstrations in the Control of Potato Leafhoppers and Hopperburn; E. W. Mendenhall, Observations on the European Corn Borer; W. C. Kraatz, A New Feeding Habit of a Dermestid Larva; Herbert Spencer, Aphid Parasites and Hyperparasites; C. R. Cutright, Relative Efficiency of Some Aphid Predators; R. C. Osburn The Tabulation of Specific Characters of Insects; Miss Mary Auten, Insects Associated with Spider Nests; D. M. DeLong, The Genus Deltocephalus, Some Notes on the Ecology and Distribution of the North American Species; H. L. Dozier, Male Genitalia of Delphacids; T. G. Phillips, The Chemistry of some Common Insecticides; H. A. Gossard, Hessian Fly Emergence at Sandusky, Ohio, in 1921; M. B. Jimison, Three Years of Hessian Fly Control Work in Erie County, Ohio; J. T. Potgieter and T. J. Naude, Economic Entomology in South Africa; E. C. Cotton, Notes of the Year on Inspection Work; J. W. Bugler, Control of some Greenhouse Insects; W. V. Balduf, Parasites of the Cucumber Beetle; J. S. Hine, Syrphidae Common to Europe and America; H. E. Evans, Observations on San Jose Scale in Southwestern Ohio; C. H. Kennedy, The Origin of Put-in Bay Dragon Fly Fauna; J. S. Houser, The Apple Flea Weevil; C. R. Neiswander and R. F. Chrisman, Hibernation Responses of the Asparagus Beetle. Visitor from out of state, W. H. Larrimer, Lafayette, Ind. The following officers were elected for 1922: President, T. H. Parks; Vice-President, J. S. Hine; Secretary, W. V. Balduf.

Apicultural Notes

The regular year's course in beekeeping at the University of Tennessee has fifteen students.

The American Honey Producers' League held its annual meeting at Salt Lake City, January 30 and 31.

Dr. E. F. Phillips, Bureau of Entomology, spoke on beekeeping at the Madison Square Garden Poultry Show, New York City, on January 26.

Mr. George H. Rea, formerly extension specialist in Beekeeping in New York, has resigned to take up similar work at Pennsylvania State College.

The State Inspector of Apiaries, who has his headquarters in the Office of the State Entomologist, University of Tennessee, Knoxville, is James M. Heatherly.

Fifty-six delegates and members attended the third annual meeting of the American Honey Producers' League at Salt Lake City on January 30 and 31.

Dr. E. F. Phillips will deliver one of the Ludwick Lectures of the Philadelphia Academy of Natural Sciences on April 3. Subject: "Bees and Beekeeping."

Mr. N. E. Phillips, Assistant Professor of Beekeeping at the Massachusetts Agricultural College, recently spent some time at the Office of Bee Culture, Bureau of Entomology.

The annual meeting of the stockholders of the Colorado Honey Producers' Association, was scheduled to take place at the Auditorium Hotel, Denver, March 6 and 7.

Mr. A. E. Lundie, of the Union of South Africa, a graduate student in Entomology at Cornell University, is spending some time at Washington in the Bee Culture Laboratory.

The Beekeepers of East Tennessee will have a meeting during the first week in April at Knoxville, Tennessee. This Association has a membership of 108 and is four years old.

The present officers of the Tennessee Beekeepers' Association are G. I. Matthews of Franklin, Tennessee, President; Miss Elizabeth Morris of Cedar Hill, Tennessee, Vice-President; and G. M. Bentley of Knoxville, Secretary-Treasurer.

The officers of the East Tennessee Beekeepers' Association are G. M. Bentley of Knoxville, President; G. F. Vineyard of 2414 Magnolia Avenue, Knoxville, Vice-President; and Hamilton Steele of Rogersville, Tennessee, Secretary-Treasurer.

Messrs. J. B. Bateman and Winifred S. Hull have been appointed as temporary assistants in the Bee Culture Laboratory, Somerset, Md., to assist in temperature readings on colonies of bees to be taken throughout the active season.

The Vocational Department of the University of Tennessee which has a two year's course in beekeeping, at present has a registration of fifteen students. Three of these Vocational students will be rehabilitated next month and have made arragements to start commercial beekeeping in Tennessee.

A motion picture film: "Bees: How they live and work," taken at Somerset during last summer, was recently released by the Motion Picture Laboratory of the U. S. Department of Agriculture. A second reel giving beekeeping practices for a season will soon be complete.

Warning has been sent out to the beekeepers of Tennessee to feed any weak colonies. The present winter has been a very mild one and bees have been active more or less all winter, which has caused a heavy drain on the stores for brood rearing.

Many requests are coming to the State Entomologist for the formation of a West Tennessee Beekeepers' Association. This will more than likely be perfected this spring. The Commercial Club of Memphis has extended an invitation for the initial meeting to be held at Memphis, using the Club Rooms for headquarters.

The Tennessee State Beekeepers' Association held its annual convention in Nashville, Tennessee, on January 26. The convention was attended by about 150 apiarists from this and nearby states. A splendid exhibit of bee supplies was made by the leading supply firms. The membership of the Association is 115. This Association is eight years old. The program follows:—Thursday, January 26, 1922, President's Annual Address, Floyd C. Bralliar, Madison; Report of Secretary -Treasurer, G. M. Bentley, Knoxville; Beekeeping as an Avocation, Rev. R. E. Wright, Wartrace; How I Became a Commercial Beekeeper, W. R. Walling, Hardin, Monrana; Advantages of Modern Equipment, Jere C. Frazer, Memphis; Queens, John M. Davis, Columbia; My Method of Introducing Queens, J. M. Buchanan, Franklin; Foul Brood Control, James M. Heatherly, Knoxville; Extracted vs. Comb Honey, Open Discussion by Members; Address, E. R. Root, Editor, Gleanings in Bee Culture, Medina, Ohio; Activities of the American Honey Producers' League, H. B. Parks, Secretary, San Antonio, Texas; Report of Toronto Meeting, G. M. Bentley, Knoxville.

At the Toronto meeting of the American Association of Economic Entomologists the section on apiculture appointed a committee consisting of S. B. Fracker, Chairman and Messrs. George H. Rea, of Pennsylvania, C. B. Gooderham, of Ottawa, to devise means for the protection of the United States and Canada against the introduction of the Isle of Wight disease. At that time the mite (*Acarapis woodi*), which causes the disease was known only in the British Isles but it has since been discovered on the continent of Europe and has come through the mails in a shipment from Scotland to Dr. E. F. Phillips, United States Bureau of Entomology.

The committee in correspondence determined to confine their activities to the securing of legislation against the introduction of bees from outside the United States.

They also presented the situation to the American Honey Producers' League at the Salt Lake City Meeting in February and resolutions were passed by the League favoring a quarantine action. Later developments are given on a preceding page.

Pacific Slope News

Professor S. B. Freeborn has undertaken some important poultry parasite investigations at Petaluma, California.

Mr. G. A. Coleman, apiculturist, attended the annual meeting of the State Beekeepers' Association at Visalia, in February.

Professor R. H. Smith, State Entomologist of Idaho, was a visitor at the Department of Entomology, University of California in January.

Mr. Frank B. Herbert, formerly with the Forest Insect Investigations of the United States Department of Agriculture, is with the Balfour Guthrie Company with address at San Jose, California.

Mr. D. L. Currier, formerly County Horticultural Commissioner of San Benito County, California, has accepted the position of entomologist for the San Jose Spray Company, with headquarters at San Jose.

Miss Therese Beckwith, a graduate in entomology from Stanford University in 1921, has been appointed Departmental Technician in Entomology at the Oregon Agricultural College. She will have charge of the departmental collection, library and files.

Director S. B. Doten of the Nevada Agricultural Experiment Station was a visitor at the University of California in January to confer with Dr. H. P. Severin on the curly leaf situation at Fallon, Nevada.

Professor Asa Maxon of the Great Western Sugar Company, Longmont, Colorado, called on Dr. H. P. Severin, University of California, to talk over the field investigation on the beet leafhopper which the latter has conducted the past few years in California.

Professor W. B. Herms, head of the Division of Entomology and Parasitology, University of California, has just directed the completion of a moving picture film on the general subject of Malaria. The film is complete in every detail and has been received with great appreciation wherever shown.

Mr. J. D. Neuls, formerly of the Bureau of Entomology, is now with the Pacific Platinum Works, 229 East 9th Street, Los Angeles, California. Mr. Neuls formerly specialized in hydrocyanic acid gas fumigation and has considerable unpublished fundamental data. He will be glad to help any one investigating fumigation problems.

Mr. Ralph H. Smith, Station Entomologist of Idaho, with headquarters at Twin Falls, has accepted a position with the California Central Creameries as Research Entomologist, the appointment to take place March 1. Mr. Smith's work will have to do particularly with investigations of insecticides and the uses and limitations of commercial caseinate spreaders.

Dr. E. C. Van Dyke has been going to Monterey week ends during the past few months to advise the Del Monte Properties Company in regard to the control of a number of bark beetles which have been doing a great amount of injury to the Monterey pines on their extensive holding comprising over a thousand acres.

According to *Science*, Professor Warren T. Clark, professor of agricultural extension work, University of California, has been invited as a guest of the Pacific Mail Steamship Company to study the control of ants on shipboard. He sailed on December 12, on the Columbia which makes Mexican and Central American ports, passing through the Canal and proceeding by way of Havana to Baltimore.

The next regular meeting of the Pacific Slope Branch will be held in connection with the meeting of the Pacific Division of the American Association for the Advancement of Science and affiliated societies at Salt Lake City, June 22-24, 1922. A summer meeting of the A.A.A.S. is also to be called at Salt Lake City at the same time, and we of the Pacific Slope Branch are very anxious for our parent Association to meet with us at that time. E. O. Essig, Secretary.

Horticultural Inspection Notes

The Sorrel Cutworm, *Acronycta rumicis* L., was recently intercepted on fruit seedlings from France by Mr. T. T. Haack of Pennsylvania.

An amendment to the Minnesota quarantine on account of the European corn borer, effective February 25, 1922, includes the States of Pennsylvania, Ohio and Michigan and the Province of Ontario.

Since the first of the year, ninety-one nests of the White Tree Pierid, *Aporia crataegi* L., have been intercepted by State and Federal inspectors on fruit and rose stocks arriving from France.

Thus far, only two nests of the Brown-Tail Moth, *Euproctis chrysorrhoea* L., have been reported this season on fruit stock from France. One was found by State Inspector Dodge of New York on pear, and the other by Messrs. Zappe and Sealy of Connecticut, on Apple.

Apple stock from France is showing a relatively heavy infection with Hairy Root, which has been reported by a number of state inspectors. Recently Professor G. M. Bentley of Tennessee reported the finding of 7,210 infected plants in two shipments of French apple stock, consisting of 148,000 plants.

At the request of the President of the Association of Nurserymen, the conference on plant quarantines originally called to meet in Washington on March 15, and postponed at the request of the Society of American Florists and Horticulturists to April 19, has again been postponed until May 15.

The Annual Letter of Information, published by the Federal Horticultural Board which lists the pests collected on imported plants and plant products from January 1 to December 31, 1921, inclusive, has been compiled and will shortly be released in printed form. Copies of this letter will be available for distribution to all inspectors engaged in the examination of foreign plant material.

Mr. Emile Kostal, an inspector of the Federal Horticultural Board, located in New York City, recently discovered living larvae of the Pink Bollworm in cotton seed which was mixed with cotton lint used as packing around souvenirs from St. Kitts. This interception emphasizes the possibility of introducing the Pink Bollworm in cotton and cotton waste used as packing for glass, china, or other articles.

Mr. Ivan Shiller, who has recently completed postgraduate work at the Texas Agricultural and Mechanical College, College Station, Texas, was appointed Plant Quarantine Inspector with assignment at Del Rio, Texas. Mr. Robert A. Rodgers, formerly of the Forest Service, was recently transferred to the Federal Horticultural Board and located at Nogales, Arizona. Both of these men are assigned to the Plant Quarantine Inspection Service.

An attempt to smuggle into the United States, Mexican oranges in violation of Quarantine No. 5 (Mexican Fruit Fly) promulgated August 30, 1912, was recently thwarted by Federal Inspector Vernon J. Shiner, who discovered a number concealed under the rear seat of an automobile arriving at Laredo, Texas. Mr. H. H. Willis, who is in charge of the work of the Plant Quarantine Inspection Service at El Paso, reports that an attempt was made by two Mexicans early in January to smuggle a quantity of sugar cane into the United States from Juarez in violation of Quarantine No. 15, issued June 6, 1914. Steps have been taken to prosecute in both instances, the offenders at El Paso being jailed on account of inability to pay bail.

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(Continued)

JOINT SESSION OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO AND THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Friday, December 30, 1921, 1.30 p. m.

President Dean presided while four papers were being presented and discussed that were left over from the program of the previous afternoon. At the close of these papers, Mr. Arthur Gibson, President of the Entomological Society of Ontario, presided during the rest of the session.

PRESIDENT GEORGE A. DEAN: The first paper is by P. A. Glenn.

RELATION OF TEMPERATURE TO DEVELOPMENT OF THE CODLING-MOTH

By P. A. GLENN, *Chief Inspector, Division of Plant Industry, State Department of Agriculture, Urbana, Illinois*

The purpose of this paper is to give briefly some of the results of a study recently made of the relation of climatic conditions to the development of the codling-moth and especially to the time of appearance of the several broods of the moth. The study is based upon data collected during a period of three years, 1915, 1916, 1917 at three localities in Illinois.

The purpose of the study was to find some temperature unit so related to development that the sums of these units which accumulate

during the period of any stage of the insect would be the same for all temperatures.[1]

The unit of temperature used is the day-degree. It may be defined as a temperature of one degree acting for a period of one day.

Table 1 gives the results of the studies on the incubation period based upon observations on 4175 eggs.

TABLE 1. TEMPERATURE AND THE INCUBATION PERIOD OF THE CODLING-MOTH

MEAN DAILY TEM.	PERIOD	DAILY DAY-DEG.			TOTAL D.DEG.	
		+50°	2(+88°)	+50°—2(+88°)	+50°	+50°—2(88°)
61.60	14.00	12.30		12.30	172	172
63.11	12.67	13.31		13.31	170	170
64.94	10.66	15.13		15.13	161	161
67.48	9.35	17.47		17.47	163	163
69.01	8.67	19.01		19.01	165	165
71.33	7.72	21.33		21.33	165	165
73.12	7.00	23.12	.01	23.11	162	162
74.86	6.60	24.86	.45	24.41	164	161
77.43	6.12	27.43	.96	26.47	165	159
78.71	5.95	28.71	.96	27.75	171	165
80.14	5.71	30.14	1.93	28.21	172	161
82.86	5.52	32.86	3.74	29.12	181	161
84.00	5.53	34.00	4.66	29.34	188	162
	7.67	21.70		21.33	166	163

The average mean daily temperatures which prevailed during these observations varied from 61.6 to 84 deg. Fahr. and the periods from 14 to 5.52 days. Development of the egg proceeds only at temperatures above 50 deg. Fahr. The rate of development increases as the temperature rises above 50 deg. until it reaches 88 deg. at which point development is at the maximum rate. The third column gives the average daily day-degrees above 50 deg. and column 6 gives the product of the day-degrees in column 3 by the periods in column 2. These products are fairly uniform for the lower temperatures,[2] but increase at the higher temperatures, because during the warmer part of the season the temperature for a part of the time was above 88 deg. and the day-degrees in column 3 contain some day-degrees above 88 deg., which retard development. To make the needed correction in the day-

TABLE 2. TEMPERATURE AND THE LARVAL PERIOD OF THE CODLING-MOTH

MEAN DAILY TEM.	PERIOD	DAILY DAY-DEGREES			TOTAL DAY-DEG.	
		+50°	2(+85°)	+50°—2(+85°)	+50°	+50°—2(+85°)
69.45	35.57	19.45	.34	19.11	692	680
70.88	32.29	20.88	.30	20.58	674	665
73.48	29.20	23.48	.72	22.76	686	665
74.53	28.62	24.53	.74	23.79	702	681
76.74	27.14	26.74	.40	25.34	726	688
79.39	25.93	29.39	3.62	25.77	762	668
80.30	26.35	30.30	4.36	25.94	798	683
74.31	29.07	24.31		22.75	719	673

[1]Humidity and evaporation under out-of-door conditions have such a slight effect upon the rate of development that for practical purposes they may be disregarded.

[2]An exception should be noted in the case of the total day-degrees when the mean daily temperatures averaged 61.6 and 63.11 degrees. The total day-degrees at these temperatures are greater than at other temperatures. This indicates that possibly the threshold of development is greater than 50 deg.

degrees on account of temperatures above 88 deg. twice the day-degrees above 88 were subtracted from the day-degrees above 50. This gave the effective day-degrees recorded in column 5. Multiplying the day-degrees in column 5 by the periods in column 2, we get the sums of day-degrees, or the total day-degrees, recorded in column 7, which are quite uniform for all temperatures.

Proceeding with the data on the larval period as we did with the data on the incubation period, we find that if twice the number of day-degrees above 85 be subtracted from the day-degrees above 50, we shall have temperature factors in column 5, which when multiplied by the periods in column 2, give products which are fairly uniform in size. The number of larvae observed was comparatively small, being only 344, and the wider variation in the products as compared with the products in the table of data on the incubation period is due to this fact. It is generally true that the greater the number of observations the more nearly does the average of the products approach a constant.

TABLE 3. TEMPERATURE AND THE PUPAL PERIOD OF THE CODLING-MOTH

MEAN DAILY TEM	PERIOD	DAILY DAY-DEG.			TOTAL DAY-DEG	
		+52°	2(+87°)	+52°–2(+87°)	+52°	+52°–2(+87°)
52.60	45.50	5.19		5.19	236	236
55.70	35.20	6.80		6.80	238	238
56.15	34.01	7.08		7.08	241	241
58.50	27.77	8.69		8.69	241	241
69.28	13.80	17.31		17.31	239	239
70.79	12.70	18.79	.04	18.75	239	239
73.11	11.51	21.11	.24	22.87	243	240
74.92	10.73	22.92	.42	22.50	246	241
76.77	10.02	24.77	.88	23.89	248	239
79.14	9.44	27.13	1.63	25.50	256	241
80.88	9.43	28.88	3.52	25.36	272	239
82.68	9.24	30.68	4.12	26.56	284	245
	14.49	17.38	.77	16.61	252	241

The above table is based upon observations on 3817 pupae. To secure temperature factors for the pupal stage which when multiplied by the periods would give nearly the same results for all temperatures, it was necessary to subtract twice the day-degrees above 87 degrees from the day-degrees above 52 degrees.

We concluded therefore, that the threshold of development for the egg and larva is approximately 50 deg. Fahr. and for the pupa approximately 52 deg. Fahr., and the degree of the maximum rate of development for the egg is about 88 deg. Fahr., for the larva 85 deg. Fahr., and for the pupa 87 deg. Fahr., that the effective day-degrees for any day may be found by subtracting twice the day-degrees above the degree of the maximum rate of development from the day-degrees above the threshold of development, and that the sum of the daily day-degrees for all the days in the period will be the theoretical thermal constant. This constant in the case of the incubation period is about 163, the larval period 673, and the pupal period 241, (265 if 50 deg.

Fahr. be taken as the threshold of development.[3]) The sum of the effective day-degrees is not a constant in individual cases, but the average of the sums in a large number of observations approaches a constant.

Variations from the average were comparatively large in individual cases. These were due partly to the use of the day as the unit of time, partly to local conditions by reason of which the temperature of the specimen was not always the same as that of the recording instrument, possibly partly to humidity and evaporation, and in the case of the larva to differences in the character of food.

After all allowances were made for variations caused by factors which were measurable, the variation in the sums of effective day-degrees which must be attributed to other causes were for the incubation period from about 156 to 170, for the larval period from about 527 to 873 and for the pupal period from about 256 to 274. Adding these together we have for the three periods a minimum of 939, an average of 1101 and a maximum of 1317.

From a computation of the sums of effective day-degrees for the entire development period of over 200 individuals kept under observation from the dates when the eggs were laid to the dates when the adults emerged, using 50 deg. as the threshold of development and 86 deg. as the degree of maximum rate of development, the minimum sum was about 950, the average 1120 and the maximum about 1350.

Data on the seasonal history were secured by noting the dates of appearance of the first eggs, larvae and adults of the several generations and computing the total number of effective day-degrees that had accumulated on these dates after January 1. The average accumulations are shown in the following table, each of the averages being based upon from 4 to 7 observations:

TABLE 4

	Effective day-degrees
1st pupa of hibernating generation	109
1st adult of " "	339
1st egg of first "	406
1st larva of " "	578
1st pupa of " "	1074
1st adult of " "	1308
1st egg of second "	1414
1st larva of " "	1551
1st pupa of " "	2169
1st adult of " "	2387
1st egg of third "	2471
1st larva of " "	2632

[3]For practical purposes it is necessary to use the same threshold of development for the pupa as for the egg and larva. If 50 deg. is used for the pupa instead of 52, the sums of the effective day-degrees will be 265.

Owing to the comparatively small number of observations used in making the above averages the results are not very consistent. They show an average accumulation of 1027 day-degrees for the complete life cycle; that is, from egg to egg, larva to larva, etc. In making the observations no doubt the first individuals were not noted in every case, consequently 1027 day-degrees is probably greater than the actual number that accumulate between the time of appearance of the first individuals of one brood and the first individuals of the next brood.

The minimum accumulation of effective day-degrees during the development period found by adding the minimum for the egg, the larva, and the pupa was 939, the minimum found by treating the entire development period as one period was 950. To get the minimum accumulation for the complete life cycle, we add 50 day-degrees to each of the above to allow for the accumulation during the time which elapses between the date of emergence of the moth and the date of egg deposition. This gives 989 and 1000 respectively as the minimum accumulations for the complete cycle. The average of these three minimums, 989, 1000 and 1027 is 1005. Therefore, after the first individuals of one brood appear we may expect the first individuals of the next brood to appear when 1000 effective day-degrees have accumulated. An equitable distribution of these 1000 effective day-degrees between egg, larva, pupa, and the interval between the emergence of the adult and the deposition of the first eggs would be 158, 532, 260, and 50 respectively. Now if we revise table 4 so as to make it consistent with the above distribution of effective day-degrees, we have the approximate number of effective day-degrees which will have accumulated at the time of the appearance of the first individuals of each of the broods during the season. These are shown in table 5.

TABLE 5.—APPROXIMATE NUMBER OF EFFECTIVE DAY-DEGREES WHICH WILL HAVE ACCUMULATED WHEN THE FIRST INDIVIDUALS OF EACH BROOD APPEAR.

		Effective day-degrees
1st pupae, hibernating generation		82
1st adults, "	"	342
1st eggs, first	"	392
1st larvae "	"	550
1st pupae "	"	1082
1st adults "	"	1342
1st eggs, second	"	1392
1st larvae, "	"	1550
1st pupae, "	"	2082
1st adults "	"	2342
1st eggs, third	"	2392
1st larvae, "	"	2550

We believe that table 5 shows quite accurately the relation between temperature and the time of appearance of the first eggs, larvae, pupae and adults of the three generations of the codling-moth in central and southern Illinois. These relations will probably hold true in other fruit-growing States, but difference in latitude, altitude, and conditions as to moisture may modify them. Should this be the case, it will be easy to ascertain the relations which apply to localities in which these modifying conditions prevail.

The advantages to be derived from the use of a table showing the relations of effective day-degree accumulations to the seasonal history of the insects are apparent. Temperature records are much more easily kept than records of the progress of the seasonal history of the codling moth based upon field observations and the former are more accurate than the latter. A spray program based upon the above table can be made out and the dates when the sprays should be applied anticipated a week or more in advance. By the use of temperature records the no•mal daily accumulations and the total accumulations for every day of the season may be ascertained for any locality and from these data the dates when the first individuals of each brood may be expected to appear under normal conditions may be known for that locality.

Spray programs based on fixed dates or on the time of the fall of the petals do not take into account seasonal variations and variations due to local peculiarities, to altitude, to latitude, or to other circumstances which may affect temperature.

The following program is suggested based upon the relation of accumulated effective day-degrees and the time of the appearance of the first larvae of each generation. The program provides for seven sprays, three for the first brood, two for the second, and two for the third. This program is suggested with the hope that it will be thoroughly tested and freely criticised.

TABLE 6.—SPRAY PROGRAM FOR THE CODLING MOTH

			Accumulation of Effective Day-degrees at which spraying should begin to be completed in:										
Spray	Brood of Larvae	Daily Effective Day Degrees	0 da.	1 day	2 da.	3 da.	4 da.	5 da.	6 da.	7 da.	8 da.	9 da.	10 da.
1st[1]													
2d	1st	16	550	534	518	502	486	470	454	438	422	406	390
3d	1st	20	790	770	750	730	710	690	670	650	630	610	590
4th	2d	26	1550	1524	1498	1472	1446	1420	1394	1368	1342	1316	1290
5th	2d	27	2050	2023	1996	1969	1942	1915	1888	1861	1834	1807	1780
6th	3d	27	2550	2523	2496	2469	2442	2415	2388	2361	2334	2307	2280
7th	3d	23	3050	3027	3004	2981	2958	2935	2912	2889	2866	2843	2810

[1]The application of the first spray for the codling moth should begin when the petals are about two-thirds off. The time of full bloom is not dependent upon effective day-degrees as defined in the preceding pages and hence the time of the application of the first spray cannot be determined by the accumulation of effective day-degrees.

Mr. T. H. Parks: I would like to know how Mr. Glenn arrived at the conclusion that humidity and evaporation are negligible factors in determining these results? With some other insects, we feel that these factors are even greater than temperature.

Mr. P. A. Glenn: The remark did not apply to the Hessian fly or some other insects, but merely to the codling moth.

Mr. T. H. Parks: How do you arrive at that conclusion?

Mr. P. A. Glenn: It would take 15 minutes or more to explain that. Humidity does have an effect if you use extreme humidity, but we don't get extreme humidities over a long period of time under field conditions.

Mr. W. C. O'Kane: May I ask Mr. Glenn if, in speaking of day degrees, you get at it by the average temperature for the day?

Mr. P. A. Glenn: Yes. Above 50 or any degree we want.

Mr. W. C. O'Kane: Suppose there were ten hours in a day and in getting at the average you had a comparatively low temperature at the beginning of the day, and then a long period of an optimum, and then drop to a low temperature, as one example; while in another day you had a comparatively high temperature and such a total as would still give you the same average; could you disregard the hourly temperatures during the day?

Mr. P. A. Glenn: Yes, My method in making the average was from a continuous record of the temperatures. I added the temperatures for each hour and divided by twenty-four to get the average for the day.

Mr. F. C. Bishopp: I was very much interested in this practical application of these laws of temperature, and I believe it is possible to utilize them to a large extent in our economic procedure; but it seems to me there is necessity for continued work over a good many years in order to eliminate the various factors which creep in to interfere with our theoretical laws or rules.

In that connection I would like to ask Professor Glenn something of the duration of his investigations. How long did they cover?

Mr. P. A. Glenn: Three years.

Mr. F. C. Bishopp: As I believe you brought out, in the egg stage for instance, reckoning the day as a unit, there is considerable error when only a portion of a day is utilized in the transformation.

Mr. P. A. Glenn: It is only by average of a large number that we arrive at something near the correct results. If we take the day as the unit, the actual length of the period may be nearly a day longer or shorter than the observed time.

President George A. Dean: The next paper is by Mr. Peterson.

FURTHER OBSERVATIONS ON THE USE OF PARADICHLOROBENZENE FOR THE CONTROL OF THE PEACH TREE BORER

By ALVAH PETERSON, New Brunswick, N. J.

(Withdrawn for publication in a bulletin)

MR. GLENN W. HERRICK: Does it make any difference in the application between the northern and southern half of the State?

MR. ALVAH PETERSON: September 15 for the northern half, and October 1st for the southern half. Due to the fact that you never find females after September 1st in the northern half, and in the southern part after September 15th to 20th.

PRESIDENT GEORGE A. DEAN: The next is a joint paper by E. R. Sasscer and C. A. Weigel.

FUMIGATION WITH HYDROCYANIC-ACID GAS IN GREENHOUSES ON A COMMERCIAL BASIS

By E. R. SASSCER and C. A WEIGEL

Although the use of Hydrocyanic-Acid Gas in greenhouses for the purpose of controlling insect enemies is frequently referred to in entomological literature, as well as in florist trade papers, there are very few instances where an accurate account of fumigation on a commercial scale has been made. For the most part, these articles are of a general nature, and the authors quite frequently fail to take into consideration the effect that such factors as heat, moisture, light, exposure, quality of the chemicals, and formulae employed would have on the final results. Many valuable plants have undoubtedly been injured on account of inaccurate fumigation, and doubtless, it is on this account that we find many florists prejudiced against the use of Hydrocyanic-Acid Gas under glass.

The work which has been carried on by the authors for the past eleven years indicates that under proper conditions, Hydrocyanic-Acid Gas is very effective in controlling the more important greenhouse insects without appreciable injury to the infested plants.

It is recognized that plants vary in their susceptibility to injury by Hydrocyanic-Acid Gas, a problem which is increased in a house containing a miscellaneous collection. Incidentally, plants in certain stages of development bear considerable succulent growth which is sure to be injured if the gas is used in sufficient concentration to kill

TABLE I. RESULTS OF FUMIGATION OF COMMERCIAL GREENHOUSES

Plants	Insects	Ozs. NaCN per 1000 cu. ft.	Contents of House cu. ft.	Exposure Hours	Temperature °F. Inside House	Temperature °F. Outside House	Relative Humidity Pct.	Results
Ageratum	*Trialeurodes vaporariorum* Westw.	1/8	27,415	1	43.8	25	—	Excellent kill of adults. No burning of plants.
"	" " "	1/8	27,415	1	50.1	25	96	
"	" " "	1/4	27,415	1	64	56	82	
"	" " "	1/4	27,415	1	59	41	78	100% kill of adults. No burning of plants.
"	" " "	1/4	27,415	1	—	—	—	
"	" " "	1/4	27,415	1	60	58	70	
Carnation	*Thrips tabaci* Lind.	1/2	150,000	1–1/2	70.3	—	98	Fully 95% of exposed thrips killed in each experiment and decided stimulation in growth of plants followed. Unopened buds developed a ringing in the form of a white discoloration, which however did not affect the value of the crop.
"	" " "	1	75,000	1	59.8	54	83	
"	" " "	1	146,000	1	57.	48	85	
"	" " "	1	144,000	1	63.3	—	78	
"		1/2	148,000	1	60	21	65	
"	" " "	1/2	338,000	1	59	36	78	
Laurus nobilis	*Coccus hesperidum* Linn.	5	46,530	1	48	30	93	Results excellent in each experiment, but in order to eliminate the scale three exposures were necessary. Vigorous new growth followed fumigation.
" "	" " "	5	46,530	1	53.4	40	87	
" "	" " "	5	46,530	1	52.5	35	84	
Miscellaneous (68 genera represented)	*Orthezia insignis* Doug.	2/3	42,000	1	69	—	86.5	95% of adults killed; eggs not affected. Slight tip burning on dahlias, salvias, jasminum, ligustrum, stephanandra, lantana, and ageratum.
"	" " "	2/3	42,000	1	69	70	81	
Miscellaneous (33 genera)	*Orthezia insignis* Doug.	1/2	17,000	1	64	—	97	85% kill—all stages: slight tip burning–Amaryllis. Severe burning—Pilea. 98% kill. Slight tip burning on Bouvardia, Pennisetum and avocado.
"	" " "	3/4	17,000	1	71.5	70	72	

Miscellaneous (Tropical—15 genera)	*Saissetia oleae* Bern.	1–½	18,000	1	69	—	88	100% kill; no eggs hatched. Slight burning of tender foliage of Cestrum, Malvaviscus, Salix, Ligustrum and Forsythia.
Orchids	*Euthrips orchidii* Moult.	½	5,307	1	69.8	—	93	100% kill of exposed nymphs and adults. Very slight burning of Coelogyne, Dendrobium, and Cattleya. Injury negligible. Of the 473 plants treated many were in full bloom.
"	" " "	½	5,121	1	73.1	—	94	
"	" " "	½	5,307	1	68.5	68	78	
"	" " "	½	5,121	1	72.1	66	73	
"	" " "	½	5,307	1	64.8	—	66	
"	" " "	½	5,121	1	68.6	—	78	
"	" " "	½	5,307	1	69.2	56	66.5	
"	" " "	½	5,121	1	73	56	69.5	
"	" " "	½	5,307	1	71.5	64	90.5	
"	" " "	½	5,121	1	73.2	64	82	
Palms, misc.	*Ischnaspis longirostris* Sign.	2–½	37,000	1	59.1	20	72	Scale mortality excellent. Slight burning on some Kentias 10 days after exposure to gas probably due to excessive sunlight which followed the day after the last fumigation.
" "	" " "	2–½	37,000	1	61.2	22.4	73	
" "	" " "	2–½	37,000	1	68.7	35	61	
Roses—2500	*Paria canella* Fab.	2	34,612	1–¾	85	80	—	A minimum of 95% of exposed beetles killed in all experiments. Plants resting at time of fumigation. Tender growth burned. *Muslin curtains used to separate houses.
" 2500	" " "	1–½	34,612*	1¾	78	76	—	
" 3600	" " "	2	47,449	2	76	75	—	
" 3600	" " "	2	47,449	2	75	72	—	
" 3600	" " "	1–½	47,449*	1–¾	78	76	—	
" 3000	" " "	2	30,408	1–¾	75	75	—	
" 3000	" " "	2	30,408*	1–½	76	75	—	
" 3000	" " "	2	30,408*	1–¾	72	72	—	
" 3000	" " "	2	30,408*	2	73	71	—	
" 7300	" " "	2	108,536*	1–½	76	75	—	
" 7300	" " "	2	108,536*	1–¾	72	72	—	
" 2800	" " "	1–¾	33,299*	1–¾	71	70	—	
" 6400	" " "	2	79,488*	2	84	83	—	
" 4100	" " "	2	59,823*	2	66	62	—	
Roses	*Paria canella* Fab.	2	146,315	2	—	—	—	Results on insects same as above. Resting period over and abundance of new growth present which was burned back to hard wood. Injury completely outgrown within five weeks.
"	" " "	2	78,412	2	76.9	—	91	
"(American Beauty)	" " "	1–½	114,061	2	75.3	—	92	

insects; as for example, roses can be safely fumigated during the resting period at the rate of 2 ounces of Sodium Cyanid per 1000 cubic feet of space, whereas, in the forcing period ½ ounce may cause serious injury under unfavorable conditions. In commercial fumigation, therefore, these conditions must be borne in mind, it being understood that a house should not be fumigated until the maximum dosage for the plants involved has been determined.

The experiments summarized below were conducted after preliminary tests had been made to determine the necessary dosage to kill the insects, and at the same time not injure the plants.

Conclusion

The results contained in the above table indicate that:

1. The common greenhouse insects can be controlled by persistently using weak dosages.

2. These dosages, under the proper conditions, will not reduce the market value of the plants.

3. Greenhouse plants for the most part show decided stimulation, resulting ultimately in a greater financial return.

4. Large houses may be satisfactorily separated by the use of canvas or muslin curtains, thus obviating a serious problem of the past in open range houses.

5. It is evident from the results thus far obtained that some plants may be fumigated while in bloom without injury to the flowers; for example, carnations and orchids.

Aside from the above facts, the cheapness of fumigation as contrasted with the cost of spraying is an additional argument in favor of this method of controlling insects in commercial greenhouses.

Formula Employed:

For each ounce avoirdupois of Sodium Cyanid (containing approximately 51% cyanogen), 1½ liquid ounces of Sulphuric Acid (1.83 specific gravity) and 3 liquid ounces of water were used. This is a slight divergence from the formula which has been generally accepted owing to the necessity of securing sufficient dilute acid to submerge the cyanid. Under greenhouse conditions, it is necessary to use a number of generators in order to secure an equal distribution of the gas, and as this number is increased, the amount of chemicals in each generator is proportionately decreased, which will result in poor generation unless there is a slight excess of water. If it were possible to have a number of small generators considerably constricted at the bottom it would be possible to get a satisfactory generation with the 1-1½-2 formula.

Mr. R. L. Webster: I would like to ask Mr. Sasscer what conditions he thinks are favorable to fumigation injury?

Mr. E. R. Sasscer: There are a number of factors which may cause injury. Fumigating in the daylight, fumigating when you have a

very high temperature, fumigating on an especially cold night and allowing the plants to become chilled, when the ventilators are open to permit exit of gas. Moisture in the house will not materially affect the result except that if the walks and soil are very wet, they will absorb so much of the gas that the fumigant will not be effective against the insect.

Mr. R. L. Webster: In some of the work that I did in New York State, it seems that moisture—particularly inside the plant—not moisture on the outside or the moisture of the air—was conducive to injury. It seems that the gas enters a plant in the same way that carbon dioxide does; through the stomates. It gets into the intercellular spaces, and then if there is a good deal of moisture it penetrates readily into the cells, causing injury. A good deal of this is theoretical but it seems to work out pretty well. It is largely a question of moisture in the cell walls of the plants.

President George A. Dean: The next paper is by C. A. Weigel and Charles F. Doucette.

FURTHER OBSERVATIONS ON THE STRAWBERRY ROOT WORM[1] ON ROSES

By C. A. Weigel and C. F. Doucette

In a preliminary report[2] given in an earlier number of this Journal the seriousness of this insect as a menace to greenhouse roses was discussed. Since then a careful survey has given evidence that this insect is now of prime importance to rose growers in practically all of the commercial rose districts of the United States, and in several establishments the plants have been almost totally ruined for commercial purposes. An active investigation of the life history and control measures was inaugurated by the Bureau of Entomology in 1919, and since February 1920 conducted as a joint project in cooperation with Prof. J. G. Sanders, Director Bureau of Plant Industry, Pennsylvania, with laboratory headquarters at Doylestown, Pa. The preliminary life history studies which were started by Messrs. Weigel and Chambers were subsequently taken up by the writers, assisted at intervals by Messrs. Primm and Buckman of the Pennsylvania Bureau of Plant Industry.

Life History and Habits

The Egg: In the life history studies it was found that the eggs were deposited in the curled-up, dead and dried leaves, singly or in masses

[1] *Paria canella* Fab.
[2] Jour. Econ. Ent. v. 13, pp. 226-232.

up to 15, averaging about four per mass, and records show that a female may lay as many as 216 eggs during its life. The period of incubation varies from a minimum of seven (7) days to a maximum of twenty-seven (27) days. When first laid the eggs are white in color, later becoming yellow, and each egg mass is surrounded almost invariably by a heavy cement-like secretion. The egg is about 1 mm. in length and elongate oval in shape. While egg-laying is continuous throughout the first eight months of the year, there are two periods when egg deposition is particularly marked, viz., in March and April and in June and July.

THE LARVA: The newly hatched larvae, which are very active, enter the soil immediately where the development of both larvae and pupae takes place. The full grown larvae are about 5 mm. long; white in color; except the head and tips of claws which are brownish; resembling white grub larvae except for size. It was found that the larvae require from sixty to seventy-four days to complete growth. In this stage considerable injury is done to the roots of the plants.

THE PUPA: When ready to pupate the larva hollows out a cell in the soil and there transforms to the pupa which emerges as an adult after eight to thirteen days.

As high as twenty-three specimens of the soil forms, i. e., larvae and pupae have been found around the roots of a single rose plant at depths varying down to four inches. The greater part of the larvae and pupae are usually located directly in the ball of roots.

THE ADULT: The average longevity of the adult has not yet been definitely determined owing to the long period of egg-laying and subsequent overlapping of broods. Adults collected in the greenhouses and kept under constant observation have lived a maximum of 141 and 156 days. Adults reared from pupae in early June lived (1) Dec. 3—160 days.—(2) Dec. 23—180 days and in that period deposited about 40 eggs. Further experiments are now in progress to determine the remaining features of the adult stage.

SEASONAL HISTORY: From the observations thus far taken it appears that the adults which emerge in September and October spend the winter hiding in mulch or soil, occasionally coming out to feed on clear sunny days. After early February they are found more frequently on the plant. Egg laying commences the latter part of February and continues through March and April with some egg-laying at all times throughout the spring months. Adults are not very numerous during the latter part of April and in May, but appear in large numbers in June and July. During the latter two months a considerable num-

ber of eggs are laid. In September and October the adults again become numerous and these adults are evidently the ones which live over the winter. After August very few eggs are laid; however, during most of the year all forms may be found in the soil. From the above it is apparent that there are at least two generations a year under greenhouse conditions.

Experiments in Control of Soil Stages

In view of the fact that the larval and pupal periods, which require from six to eight weeks, are spent in the soil, our efforts during the first season were largely directed to the finding of some soil application, either an insecticide or a fertilizer, which would operate against these stages and hence prevent the emergence of the adults. With this object in mind the following materials were tried out during the season of 1920.

a. Carbon bisulfide—5 to 25 cc injected between bushes approximately 14″ apart.

b. Carbon bisulfide in solution—¼ to ½ ounce dissolved in four gallons water applied to twenty-four square feet.

c. Sodium cyanide in solution—⅛ to ½ ounce per gallon of water applied to six square feet.

d. Cyanamid—½ to 2 lbs per 40 sq ft.

e. Acid Phosphate—200 lbs to 1200 sq. ft.

f. Wood Ashes—200 lbs to 1200 sq. ft.

g. Tobacco Dust—200 lbs. to 1200 sq. ft.

h. Hydrated Lime—200 lbs to 1200 sq. ft.

The above applications were based on one plant per square foot. Applications of the last five materials were followed by thorough watering to insure prompt leaching of the active elements. Considering both plant tolerance and insecticidal value, the acid phosphate, wood ashes, and tobacco dust were the more promising.

In the season of 1921 an excellent opportunity presented itself for further experimental work along this line. At a wholesale rose establishnemt at Doylestown, Pa., a ground bed containing approximately 800 plants heavily infested with soil forms of *Paria canella* was placed at the disposal of the writers. It is interesting to note that these plants had been growing in this bed for eight years which may account for the extremely heavy infestation, where around the roots of some plants as many as twenty-three (23) individuals were found.

Preliminary tests were first conducted with potted rose plants in which a definite number of larvae and pupae from the infested bed were buried at their normal depth. The effectiveness of the following ma-

terials was tested in these pots, observations being taken either five or ten days after treatment:

Paradichlorobenzene—2 gms. to 8 gms. per plant.
Borax—1 gm. and 2 gms. in solution per plant.
Sodium cyanide—0.45 gms. to 1.77 gms. in solution per plant.
Orthodichlorobenzene—3 cc. per plant.
Mercuric chloride—(rate of ½ ounce per 3 gallons water, ½ pint per plant).
Kerosene nicotine oleate emulsion (1 part to 16 parts water; 1 part to 32 parts water per plant).
Wood ashes—handful at base of each plant.
Tobacco dust—handful at base of each plant.
Lye—one teaspoonful per plant.
Nicotine Sulfate—2 drops in 225cc water per plant.

Of these materials Paradichlorobenzene, Orthodichlorobenzene, Sodium cyanite and Kerosene Nicotine Oleate emulsion gave promising indications.

With this as a basis a total of thirty-eight plot experiments were then conducted on the infested bed using from five to twenty-five plants in each test. Examinations of the treated as well as the check plants were made at as close to five day intervals as conditions would permit by digging up the plants and examining the roots and surrounding soil for the larvae and pupae present. In this manner, observations were made on the effectiveness of the materials used as well as the minimum time which was required for them to exert their insecticidal action. The following materials were used:

Paradichlorobenzene was employed in fourteen tests in amounts ranging from five grams to one-half ounce per plant.

Sodium cyanide was tested in nine plots, using from one-half to five grams dissolved in about one pint of water and poured around the base of each plant. The same material in the dry form was applied at the rates of two, three, and five grams per plant, respectively.

Kerosene nicotine oleate emulsion in dilutions varying from one-fourth pint to one pint per gallon of water was used in five tests.

Orthodichlorobenzene was given three trials of 1cc., 2cc., 3cc., per plant respectively, applied directly at the base of the plants.

One-half ounce mercuric chloride dissolved in three gallons water, as well as tobacco dust, wood ashes, and a combination of the two, were also tested.

Results: Tobacco dust and wood ashes, alone and combined gave encouraging indications but as they are now being tried out on a commercial scale further comment is reserved. Mercuric chloride proved entirely valueless. While orthodichlorobenzene trials produced a mor-

tality of 52% at the highest dosage, its further use was precluded because of the severe injury to the plant. Kerosene nicotine oleate emulsion gave varying results as far as mortality was concerned, but owing to the greasy and objectionable condition in which the soil is left after application, this material is ruled out. Sodium cyanide in the dry form is also removed from consideration because in all the tests the plants were killed in a very short time after application. Sodium cyanide in solution gave appreciable killing (77%) but as with the dry material its severe injury to the plant caused it to be eliminated. In the trials of paradichlorobenzene excellent killing of both larvae and pupae resulted, but in practical tests it was found that the rose plants do not tolerate this substance.

In summing up these soil experiments it is seen that most materials gave negative results, either because of the plant intolerance or the ineffectiveness against the insect. It is thought that further tests of the tobacco dust and wood ashes may form a basis for the successful control of the soil stages.

Experiments in Control of Adults

Spraying: In the preliminary account[1] it was pointed out that under the usual growing conditions the use of arsenicals sprayed on the rose plants has been found to be impractical, ineffective, and objectionable. It is impractical because the forcing of the plants causes considerable new growth to push forth overnight which necessitates constant and almost daily spraying to keep all of the foliage covered with the poison; it is ineffective because it was found that the beetles avoided the sprayed portions in their feeding; and objectionable because of the whitish deposit left on the foliage.

There is, however, one phase in the culture of roses when the use of an arsenical as a spray has been proven to be effective. When the rose plants are "cut back" practically all the foliage is removed and the fresh growth develops from new buds. The absence of foliage forces the beetles to feed on the green bark as well as the swelling and breaking "eyes" or buds, causing serious retardation of the growth. By spraying the stems and swelling buds with 4 to 5 pounds powdered arsenate of lead, or calcium arsenate, to 05 gallons of water, the plants in several infested rose houses passed this critical stage during the past summer with almost no injury by the beetles.

Dusting: Experiments with powdered arsenate of lead, one part mixed with nine parts of superfine sulfur, have been carried on during

[1] *Loc. cit.*

the past two seasons as a substitute for spraying with a certain degree of success. No objectionable deposit is left on the foliage of the cut flowers because of the frequent syringing, but the ease and rapidity of application makes it possible to keep the leaves continually dusted. Besides, the fungicidal value of the sulfur for the control of leaf-spot and mildew should not be overlooked. The final conclusions on the effectiveness of the dust treatments will probably be reached during the coming season.

HYDROCYANIC ACID GAS

The use of hydrocyanic acid gas as a fumigant has been mentioned[2] as a control measure for the adult stage. Since then the successful use of this gas has been demonstrated on a practical and commercial scale. During the past season a total of approximately 32,000 rose plants were fumigated during the resting or "drying-off' period with a dosage of two ounces sodium cyanide per 1000 cu ft. of space, with an exposure of two hours and at temperatures ranging from 66° to 88° F. In some cases the houses received three or four successive fumigations. In these tests it was demonstrated that muslin curtains could be used successfully to confine the gas in any section of an open range of houses. The anticipated burning of the tender growth is a negligible factor because any such injury would be removed in the severe pruning which was mentioned previously. Of the 32,000 plants including 1000 newly set young plants, not one was lost or retarded in growth because of the fumigation.

President Arthur Gibson takes the chair.

PRESIDENT ARTHUR GIBSON: This constitutes the fifty-eight annual meeting of the Entomological Society of Ontario, and this organization is very glad to meet with the American Association of Economic Entomologists today. We appreciate the fact very much that you came to Canada and are holding your meeting in Toronto this year. The first paper is by Mr. W. C. O'Kane.

ONE YEAR OF THE CROP PROTECTION INSTITUTE

By W. C. O'KANE, *Chairman of the Board of Governors*

One year ago at this time, members of this Association were asked to give their support to a newly organized movement, the Crop Protection Institute. A similar request was made of the men in Plant

[2] *Loc. cit.*

Pathology and in Agricultural Chemistry. This paper is in the nature of a brief statement of the progress of this movement during the past twelve months and what appear to be its prospects.

Shortly after the Association met at Chicago a year ago, the first regular meeting of the Crop Protection Institute was held at Rochester, N. Y. At that time a modification of the control of the Institute was worked out, was submitted to all the members and was adopted. The management of the Institute, therefore, is now in the hands of a Board of Governors, made up exclusively of scientific men, three of whom are chosen by the American Association of Economic Entomologists, three by the American Phytopathological Society, two by the Association of Official Agricultural Chemists and one by the National Research Council, making nine members in all. This Board is responsible for the direction of the Institute.

In addition, provision has been made for the setting up of Boards of Trustees of three members for any industrial division that may be created within the Institute. Such a Board is responsible for the finances of its own division and sits in conference with the Board of Governors in consideration of matters relating to its division.

The first accomplishment of general interest carried through by the Institute was a conference on control of the cotton boll weevil by dusting. This conference was held in New York and was attended by scientists representing the Bureau of Entomology and by a number of manufacturers producing poison dusts and dusting machinery. The purpose was to standardize recommendations and to correct errors. The situation was discussed frankly and fully. Following the conference a concise statement of rules relating to dusting for boll weevil was prepared by experts of the Bureau and was placed by the Institute in the hands of manufacturers to be transmitted by them to their salesmen, agents and retailers.

At a meeting of the Board of Governors in January preliminary plans were drawn up for a cooperative dusting project, to be carried out under the direction and with the assistance of the Institute, the actual experimental work to be in charge of the entomologists and plant pathologists in the several states taking part in the project. This plan was carried through successfully and with interesting results. The necessary materials were provided by manufacturers. The experiments in the several states were carried out on parallel lines. The investigation was conducted jointly in New York state, Pennsylvania and West Virginia. A director of the project, selected by the Board, visited the various plots, and at the close of the season there was a meeting to examine data.

The results constitute a genuine contribution to scientific knowledge and will be published soon as a bulletin of the Crop Protection Institute. The project demonstrated the feasibility of looking to the institute as at least one available means to bring about profitable and desirable cooperation among investigators. The project was not an expensive piece of work. It utilized, as it should, the existing, well-equipped, and well-qualified agencies in the shape of scientific workers and laboratory equipment in the several states concerned. It simply brought these together in a mutually helpful relationship. There appears to be no reason why the Institute cannot serve as a means of furthering other broadly conceived and timely investigations.

During the year the Institute has been engaged in preliminary work on a project relating to the Ox Warbles. It is well-known to entomologists that the two species of Ox Warble that we have in this country, *Hypoderma lineata* and *Hypoderma bovis*, cause enormous losses each year to farmers and stock growers, to the packing houses that must sell grubby hides, to the tanners who must buy such hides and, eventually, to the public, who must pay an additional price for sound leather. It has long been known that, technically speaking, it should be possible to reduce damage by the Ox Warbles, at least in certain localities, for the reason that the species is in position where it can be got at beneath the hides of cattle at a certain period of each year. Cattle represent a definite quantity to which access may be had. Researches by Bishopp have disclosed a simple and not too expensive ointment that may be applied with excellent results.

The Board of Governors decided to endorse an attempt to carry out a program of control and elimination in a typical, stock-raising county in the east, in which both species of warbles are present and are destructive in marked degree. The Institute sought the assistance of the Tanners' Council, an organization representing the large tanning interests of this country, and was successful in securing from them an appropriation of $9,000, extending over a period of three years, this appropriation being contingent on the securing of other necessary funds from other sources. Approaches were made to the authorities of several counties in New York state with encouraging reception. Support was sought, also, from the Institute of the American Meat Packers, but in the recent conditions in the business world this source did not materialize. Other avenues are now being approached.

It is planned to carry out, if possible, some necessary preliminary work this present winter and it is expected that the project will, even-

tually, be carried through. The plan calls for a three-year program, involving from 40,000 to 60,000 head of cattle and under the scientific direction of experts from the Bureau of Entomology.

The Institute has undertaken to establish contacts with several other industrial groups whose interests are related to the work of the entomologist and plant pathologist. The purpose of this is to pave the way for research in these industries.

A committee of the Institute is now at work on the details of a fourfold project relating to sulphur. The four aspects of this project include: first, the action of sulphur as an insecticide, both as elemental sulphur and in its compounds; second, its action as a fungicide; third, the effects of meteorological conditions on the action of sulphur; and, fourth, sulphur in relation to soil. The committee has been in conference with two of the large producers of sulphur and has found that they are interested. The Institute expects to present a detailed plan and a budget to these producers soon.

Other industrial groups with whom conferences have been held include the following:

(1) The Cereal Division of the American Specialty Mfrs. Association, which includes manufacturers of package cereals in this country. This group is footing a bill for large losses due to insects attacking stored products. Their problem is complicated by the fact that warehouses in which package goods are stored become infested, as do the establishments of wholesale grocers, and, therefore, goods that leave the manufacturers free of insects may reach the consumers badly infested.

(2) The American Tobacco Company, in which heavy losses are resulting from the work of tobacco-infesting insects.

(3) The American Seed Trade Association. There are two problems here, one concerning losses due to insects infesting stored seeds; and, second, a problem relating to the role of seeds as carriers of pathogenic organisms. A member of the Institue has been invited to appear before the next convention of seedsmen and to present a paper explaining the second problem alluded to above.

(4) The National Lime Association. Fundamental questions are involved here, relating to the action of lime, both alone and in compounds, in relation to both insects and plant diseases. A committee representing the Institute will present soon a plan for an investigational project and a proposed budget for the same.

(5) Oil refiners. The Institute has had a preliminary discussion with one of the large oil refiners as to possible chemico-biological stud-

ies in various petroleum derivatives. It appears that a working arrangement that would utilize the laboratories and knowledge of the oil chemist with the facilities and the knowledge of the entomologist, would promise interesting results.

From time to time during the year the Board of Governors of the Institute have considered various aspects of a proposed plan by which the Institute would establish a procedure for scientific testing of insecticides and fungicides. A plan to this effect has been drawn up in tentative shape by a special committee. The committee has sought the counsel of the Federal Insecticide and Fungicide Board, with the intent that the plan if adopted shall represent a harmonious connection with the federal authorities. In general, the proposed procedure would provide that a manufacturer of insecticides or fungicides, or a producer of basic materials, can come to the Institute for a scientific study of a product, the expense of this study to be provided by the manufacturer, the funds to be administered by the Institute. It is proposed that the Board of Governors would arrange with experts among the scientific members to carry out such tests or investigation and would make proper financial arrangement therefore. The reports of the investigators would be made to the Institute. Publication of results may or may not be undertaken, according to the circumstances of the case. The intent of this procedure, if it is adopted, will be to provide an authoritative and competent agency to which the manufacturer can turn for a proper scientific study of his product and, at the same time, to discourage ill-founded or misleading claims or statements by manufacturers.

In summing up, the Institute has received cordial support from the scientific workers, including active, though unofficial cooperation from members of the Bureau of Entomology and Bureau of Plant Industry; although the latter have not yet been granted specific permission to become members. There are now, approximately, 250 scientific members of the Institue, 25 industrial members and 25 associate industrial.

The accomplishments of the first year have not been as much as might be hoped. But it is believed that a start has been made in activities that are substantial and will prove worth while.

PRESIDENT ARTHUR GIBSON: The next paper is by E. H. Strickland.

POISONED MOLASSES FOR THE DESTRUCTION OF NOCTUID MOTHS

By E. H. STRICKLAND, *Entomological Branch, Ottawa, Can.*

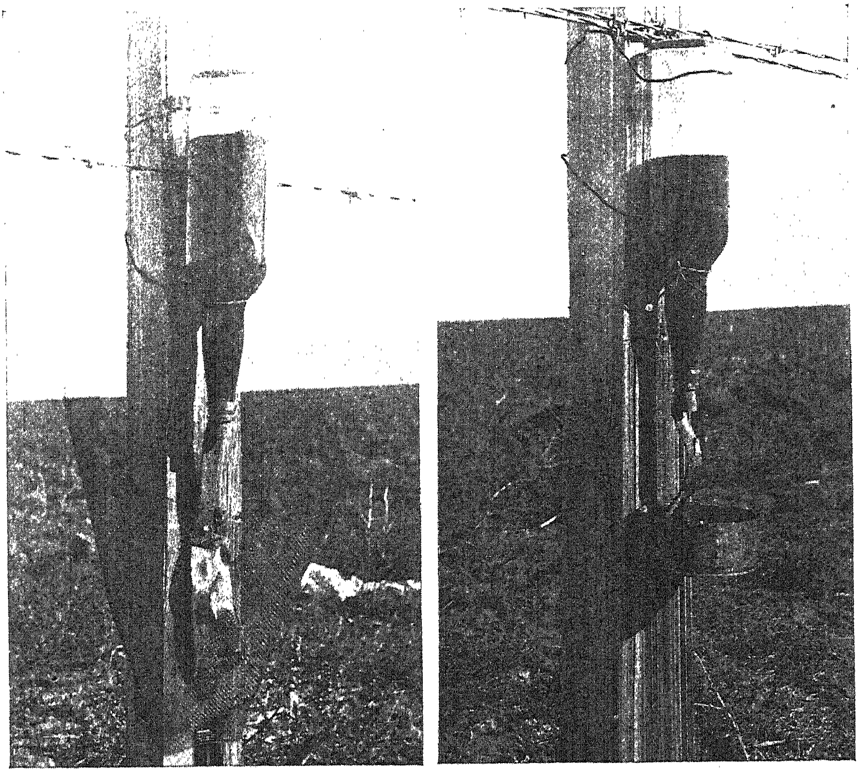
The annual loss on the western prairies from the destruction of grain crops by the Pale Western Cutworm (*Porosagrotis orthogonia* Morr.) has amounted in recent years to several millions of dollars. Numerous experiments, conducted in the infested provinces and states, have failed to produce an effective method of controlling this pest in its larval stage. For this reason the problem of destroying the adults before they have reproduced has received considerable attention.

Three methods have presented themselves to us as a possible means of gaining this end, namely, light-traps, molasses troughs and poisoned molasses. In experimenting with these we have aimed at producing a method that will have the following qualifications; all materials used are readily procurable in any farming community, very frequent attention to traps is unnecessary, and it is inexpensive to operate. The employment of poisoned molasses approaches more closely to the fulfilment of these conditions than does either of the other methods.

LIGHT-TRAPS

In 1913, we placed a few light-traps in fields around Lethbridge, where an outbreak of *P. orthogonia* had been somewhat severe. The nightly catch never exceeded fifty-eight moths of this species and of the total captures 97.5% were males. For this reason we considered the method to be economically ineffective. In 1920, Circular 94 of the Montana Experiment Station recorded a night's capture of as many as 1,500 moths of this species in individual light-traps which were of a superior type to that which we had used in 1913. This year Mr. H. L. Seamans, who has recently come from the Montana Station to take charge of the Dominion Entomological Laboratory at Lethbridge, constructed a number of traps similar to those in which these large captures were made. Two of these were set out in a badly infested field at Lethbridge and about six were operated by our assistant, Mr. W. Carter, with the help of some farmers in the very heavily infested district around Retlaw, which is about sixty miles to the north-east of Lethbridge. These traps were set out from the middle of July till September 8th, when snow and frost put an end to the flight of *P. orthogonia*. During periods of moonlight, high wind and other unfavourable weather these traps were not operated. The results were

disappointing. The largest capture of *P. orthogonia* at Lethbridge was 517 ♂♂ and 17 ♀♀, the average per "trap-night" being 84.3 ♂♂ and 2.03 ♀♀. The Retlaw traps captured 41.3 ♂♂ and 3. ♀♀ per "trap-night." Of the total capture of 34,500 speciments of *P. orthogonia* which were taken in the field by light-traps 94.97% were males. This percentage was very little better than that obtained in 1913.



1 2

Fig. 6.—The Alberta Moth Trap

1. Trap so arranged that the majority of moths will be retained.
2. The most suitable type of trap for moth destruction.

We do not know to what extend the males are monogamous in nature, but it would appear that on this factor alone depends any appreciable benefit to be derived from light-traps.

We consider light-traps to be unsatisfactory as a general method of control on the prairies for the following reasons:

1. They require attention twice daily.
2. They are somewhat expensive to operate.
3. They are practically ineffective during periods of full moon.
4. They are not well adapted to a windy country.
5. For the species under consideration they catch too small a percentage of females.

Molasses Troughs

This method was suggested by the experiments conducted by Dobrovljansky[1] for the control of *E. segetum* in Russia. Early in September 1920, three galvanized iron troughs, 2 feet long and 6 inches wide and deep, were set out in a badly infested area. Each was half filled with a 66% solution of molasses in water. On the first night they captured a total of 382 moths of which 135 were females of *P. orthogonia*. A slight crust had formed on the surface of the molasses by the following night when 16 moths only were retained. Of these 8 were females. It was obvious that we might be attracting to the field moths that we were unable to capture and that possibly our troughs were doing more harm than good to the owner.

Attempts to improve the consistency of the molasses solution failed to give satisfactory results. In a 50% solution many moths swam to the sides and escaped while any stronger solution crusted over in a very short time. Some twenty troughs were used in 1921, and attempts were made to retain the moths in weak solutions by the addition of vegetable and other oils, with tanglefoot and with poisons, but without success.

This method was early abandoned for the following reasons:

1. The troughs require very frequent attention.
2. A great many of the moths escape.

Poisoned Molasses

P. orthogonia comes very readily to "sugar" applied to fence posts. A fence post can be kept permanently "sugared" every evening for from ten to fourteen days by means of a simple apparatus. The only material required is a quart bottle with a cork to fit, 6 inches of lamp wick and a small piece of absorbent cloth. The bottle is filled with the sugaring mixture and the end of the wick, which has first been well saturated in the mixture, is inserted. A well fitting cork, that has been slightly flattened on one side by cutting away a small portion with a knife is pressed fairly tightly into the bottle with the flattened side next to the wick. The bottle is then inverted and wired or tied to the west side

[1]Extract in Rev. Applied Ent., Series A. Vol. 1, p. 490, 1913.

of a fence post, and the free end of the wick is nailed to the post through a piece of absorbent cloth. When a rapidly killing poison is used, and it is desired that material obtained be preserved, a partial funnel of mosquito netting or paper can be attached to the post as is shown in figure 6, 1. A modification, suggested by Mr. Carter, is to replace the cloth with a shallow pan made from a tomato can (Figure 6, 2). This forms a reservoir for any surplus flow of poison.

The bottle is fastened to the west side of the fence post in order that it will not be exposed to the direct rays of the sun till the afternoon. The heat then causes its contents to expand and to drive some of the liquid down the wick and on to the cloth. This action usually continues till nearly sunset and it liberates sufficient bait to attract moths throughout the night. After the sun has set a reverse pressure in the bottle draws in sufficient air to replace the expelled liquid.

Provided the variations in temperature are not too extreme, or fermentation too rapid, a quart bottle will run every evening for from ten to fourteen days. We have tried several modifications of reservoir and methods of controlling the flow of bait, such as the "drinking-fountain", siphon, and gravity feed, but find the inverted bottle to be as satisfactory as any.

Having obtained a satisfactory apparatus, our next concern was to find a suitable poisoned bait. As a basis a 10% solution of cane molasses was used in all cases. This ferments within a few days of mixing. In the fall of 1920, experiments were made in which the decantation from a saturated solution of white arsenic was used as the diluent. This killed moths in the laboratory in from 8 to 40 hours, but was found to be somewhat deterent to feeding.

When this solution was used in bottle traps moths fed on it and obtained sufficient poison to cause their death within 24 hours. This was proved by captured specimens. In the field, however, they all flew from the traps before dying. It was hoped that some immediate killer could be obtained in order that we might estimate the value of the traps, and be certain that gravid females were unable to deposit their eggs before dying. It was also highly desirable that those who might be using the traps as a practical means of control should be able to see some results from their efforts in the form of dead moths.

To this end we planned a series of experiments in 1921, but it was not until nearly the end of the season that Mr. Seamans found quassia to be the nearest approach to what we desired. Subsequent observations showed that this material must be used in conjunction with some other poison.

Among substances employed with the hope of obtaining an immediate killer were various arsenicals, soluble strychnine, copper sulphate, formalin, mercuric chloride, sodium cyanide in solution, and sodium fluoride. All of these failed to kill in less than about 12 hours except in strengths that proved to be deterrent. Arsenical poisons showed the least deterrent effect in the field when they were employed in weak solutions. Various objections to most of the forms of arsenic that are readily available to a farming community decided us to adopt commercial fly pads, at the rate of one pad per quart of solution, as the most satisfactory source of supply. At this strength the arsenic is very slightly deterrent and there is no precipitation. The pads can either be soaked in the solution over-night or be cut into strips which are inserted into the bottles. Moths captured while feeding on bottles so poisoned died in from six to one hundred hours, depending upon the amount of feeding prior to capture. The majority of poisoned moths died within 36 hours. Checks taken from unpoisoned bottles lived for an average of 130 hours without subsequent feeding.

The season was unfavourable for bait traps. A very dry summer had resulted in the failure of many crops and had seriously hampered summer-fallowing, with the result that nearly all classes of fields were covered with Russian thistle. This was flowering at the time of flight. Noctuidae feed freely on these flowers, but the favourite food plant in Alberta appears to be golden-rod, which flourishes in restricted areas of waste land. Experiments with traps placed in these golden-rod areas showed that fermenting molasses, when used alone, was not sufficiently attractive to overcome the predilection of the moths for these flowers. With the addition of eight drops of amyl acetate per quart of the solution, both sexes of *P. orthogonia* could be attracted to feed on the bait despite the close proximity of a strong counter attractant.

The abundance of feeding is very variable and we did not obtain very definite data upon the probable catches made by our experimental traps. At night there were frequently as many as 20 to 30 moths, of which over 50% were female, feeding on a single trap at a time when very few were attracted to troughs of molasses. By day males were found feeding at all hours, though they were most abundant between the hours of 2 and 5 P. M. Females appeared less frequently in the morning and were seldom seen in numbers till about 4 P. M., by which time they visited the traps freely and were nearly as numerous as the males on golden-rod blossom.

We did not discover that quassia would retain the majority of moths that visited a trap till too late in the season for this to supply us with many data.

In the laboratory, however, and with a few bottle traps, we found that the deterrent effect of quassia is very slight and that it is readily overcome by the addition of a little saccharine to the bait.

The effect of quassia on moths is very variable and it cannot be predicted for the individual. Moths captured feeding on flowers, were offered a choice of formulae. Those containing quassia and saccharine were preferred to straight molasses. This was also demonstrated in the field. At a strength of two ounces to a quart of solution quassia kills about 65% of all moths that feed on it. In some cases death is rapid, and within ten minutes of feeding either sex of *P. orthogonia* loses all power of locomotion, lies on its back and response to stimulation becomes continually less apparent till it ceases entirely. Death in such cases appears to be gradual and progressive. In other cases moths feed freely on the bait for a few minutes and suddenly flop around the receptacle as though in great pain, till sudden death puts and end to their activity.

On the other hand some 35% of the moths which have imbibed quassia solution, sometimes more extensively than have those which die, become either very sluggish or quite inactive a few minutes after feeding and they may remain in this condition for two or three days. Sometimes females, which have been quite inactive for over 24 hours, will laboriously struggle to their feet, lay a few eggs, and relapse into inactivity. Recovery in other cases appears to be complete, and since it permits oviposition, we have retained the use of fly pads in addition to quassia. Our experiments indicate that very few moths will recover from the effects of the latter before they succumb to the arsenical poison of the former.

At present our poisoned bait formula, therefore, consists of:—a 10% solution of cane molasses, the diluent being water in which quassia chips have been soaked overnight at the rate of two ounces to the quart. In each bottle of this solution is inserted one fly pad, sufficient saccharine to cover a Canadian 5 cent piece (1 gram), and eight drops of amyl acetate.

This formula undoubtedly can be improved considerably both as regards its attractiveness and poisoning ability. As it stands, all of the materials, with the exception of amyl acetate which is not essential, can be obtained in any village.

The present retail cost of materials for a dozen traps, including the bottles, is approximately $2.65.

We have no definite data as to what distribution of traps will give the greatest returns for money expended, but believe that one to every

ten rods of fencing around a field that is free from flowering weeds should be sufficient to reduce an outbreak very materially. On weedy fields subsidiary posts erected in the field might be necessary.

Poisoned molasses traps give more promise for controlling noctuid moths than do other methods tried because:—

1. They require attention, at the most, once a week.
2. Females are attracted as readily as males to bait and they are usually gravid.
3. With a combination of quassia and arsenic very few females that feed on the bait are able to lay eggs subsequently.
4. Quassia is non-poisonous to stock and is distasteful to them.
5. Individual traps attract more moths than do corresponding troughs of molasses.
6. All materials are cheap and are readily obtainable anywhere.
7. The bait is effective by day as well as by night and its efficacy is not reduced by moon light.
8. Climatic conditions affect the traps very little.

MR. GLENN W. HERRICK: What quantity of moths did these bottles kill?

MR. E. H. STRICKLAND: Unfortunately we had a snow storm before our investigation was finished, but we found that we were getting thirty to thirty-five of the females feeding at the same time at each of the bottles, and we occasionally found sixty or seventy moths feeding when only six or seven were attracted to each molasses trough. Since these bottles are much cheaper than the troughs, we found them superior in every respect. This is, however, very preliminary work.

MR. L. CAESER: I would like to ask whether they are assuming that the moths lay their eggs after taking the arsenic or if there is definite proof of it?

MR. E. H. STRICKLAND: We have definite proof that they do. We also, unfortunately, have data to prove that they may lay eggs before they take any food at all.

MR. WILLIAM MOORE: It might be of interest to know that before Prof. Berlese developed his sweetened arsenical for the fruit-fly, there is reference in Australian literature to sweetened material as a house-fly poison.

PRESIDENT ARTHUR GIBSON: Mr. Criddle will now present his paper.

THE WESTERN WHEAT STEM SAWFLY IN CANADA

By NORMAN CRIDDLE, *Treesbank, Man.*

(Withdrawn for publication in the 52d Report of the Entomological Society of Ontario.)

MR. R. L. WEBSTER: I have been greatly interested in Mr. Criddle's paper, because this, like other insects, has absolutely no regard for international boundaries. It caused a great deal of damage in North Dakota in 1921.

I would like to ask Mr. Criddle if it is possible that the same number of insects might be present per square mile over the whole area and yet the damage show entirely in the dry area?

MR. NORMAN CRIDDLE: That is the point I wish to make. The sawfly is all over the area, but it does not develop where there is a vigorous growth, and that, of course, is brought about by rainfall.

PRESIDENT ARTHUR GIBSON: The next paper is by H. A. Gossard.

PROGRESS IN HESSIAN FLY CONTROL

By H. A. GOSSARD, *Wooster, Ohio*

(Withdrawn for publication elsewhere)

MR. F. Z. HARTZELL: I would like to ask the difference between the peak of emergence and the date of plowing? Would it be safe to plow when emergence had been reached, or to wait?

MR. H. A. GOSSARD: That would depend on the density of the brood. In 1920, the brood was so dense that we felt perfectly justified in holding everybody back until the peak was passed and on the decline, because we were sure that the tail end of the brood was so heavy that if this method was not followed, we were likely to have very heavy infestation.

In 1921, the brood was not so heavy and we were not afraid of the tail end of the brood. In other words, the tail end of the brood was not going to be heavier than the normal brood. They laid their eggs a little later than we expected, but we were making observations and did not feel the need for calling for a later seeding. We allowed the farmers to go ahead and seed at the time already agreed upon, and it turned out satisfactorily. If we had had a heavy brood, we would have asked them to wait until the peak was diminishing.

PRESIDENT ARTHUR GIBSON: The next paper by Messrs. Crawford and Spencer is one of a series.

THE EUROPEAN CORN BORER (*Pyrausta nubilalis* Hubn.): LIFE HISTORY IN ONTARIO[1]

By H. G. CRAWFORD, *Entomological Branch, Ottawa*, and G. J. SPENCER, *Ontario Agricultural College, Guelph, Ont.*

The apology for presenting so incomplete a study rests upon the fact that this is a recently introduced and already widely distributed insect, spreading with great rapidity, and capable of doing very serious damage. Consequently its reaction to Canadian conditions where it has demonstrated its ability to increase over 300 per cent in a single year and where its presence results in severe damage to our corn crop, cannot but be of interest and value.

The larvae of the European corn borer normally winter in corn stalks or stubble, either standing or lying on the ground. Almost any other not absolutely submerged shelter, from corn leaf on the ground to the centre of the cob in the crib, will serve for successful wintering. In the spring as soon as the weather warms up, the larvae do a variable amount of boring and possibly feeding in preparing the pupal chambers from which an outlet for the escape of the adult is made.

Pupation in the field in 1921 began on May 30th, being practically complete by June 22d, though one or two larvae were taken in the following week. Adults began to emerge June 16th and by July 4th 90 per cent of the moths had issued, the balance following more slowly; a small percentage failed to develop.

In the laboratory where the whole process of development was delayed, pupation did not begin until June 6th, ten days later. The males began to pupate 7 days before the females, outnumbering them until just before the end of the pupation period. Similarly with the moths, the males began to emerge about 4 days before the females and exceeded them in number until just before the end of the emergence period, which extended from June 29th to August 12th. The duration of the pupation period of the males varied from 8 to 18 days, an average of 12.33 days, while for the females it was distinctly less, from 7 to 17 days, an average of 11.29. At the laboratory located a little further inland the average durations, however, were 12 days for males and 10.19 for females, a distinctly more rapid rate.

[1]A joint progress report of the life history studies carried on at the laboratories of the Dominion and Ontario Departments of Agriculture in the season of 1921, at Port Stanley, Ontario, Canada.

The male moths lived in confinement for from 6 to 21 days, averaging 13 days, while the females lived for from 10 to 31 days, averaging 17.4 days, with a pre-oviposition period (20 females) of from 3 to 9 days, averaging 4 days. After this pre-oviposition period they laid from 95 to 988 eggs per female, at the rate of from 12-231, an average of 75.3 eggs per day, in masses containing from 1-64 eggs, an average of 33 per mass. All of the eggs kept under observation hatched. The duration of this stage was from 3 to 8 days, averaging for the period between June 28th and August 2d 4.71 days.

In the field a study of the incidence of egg laying on corn planted on May 31st in a field adjacent to the northern margin of an old corn patch of 1920 at this time in oats and barley, was started. The moths began to emerge on June 18th from the old stubble in the standing grain, and eggs were not found until July 1st when 5 masses were secured from 100 plants though a most careful search was maintained in the intervening period of 14 days; on July 3d 15 masses were secured on approximately 200 plants, at which time egg laying was becoming general and some masses were observed to be hatching. The corn at this time was from 9-20 inches high. No eggs were laid until the corn averaged about 15 inches in height. In the interval the adults were, without doubt, flying southwest to another field planted on May 18th, which at this time was markedly in advance of the field under observation in development and finally suffered a loss of 65%. The field under study on the north, however, was but 63.2% infested and the loss would not exceed 5%.

The first eggs taken in the season, however, were found in the field June 21st and by July 5 hatching was general and the infestation was showing up very clearly on the unrolling leaves where the newly hatched larvae were feeding at the base. The evidence of attack became clearly marked in the first week in July and by the second week the tassels were falling on the early planted flint and sweet corn. As the plant increased in length and the larvae on the rolled up leaves were exposed to light, they bored into the stalks, which by the end of July in the early planted corn began to break over.

By the third week in July in the very early sweet corn, and to a much less extent in the flint, the majority of the larvae were full grown. At that time a very small second brood developed in the very earliest planted sweet corn, involving but a fraction of one percent of the larvae. In this sweet corn 10 pupae in all were collected between July 21st and 26th and 4 pupae were secured from larvae collected at the same time. From these pupae, after a period of 13 days, 2 male moths and

1 female moth were reared. The female laid fertile eggs, the larvae from which established themselves on a corn plant in an experimental cage. The only other evidences of the second brood were 1 pupa and 2 female pupal cases from the earliest flint corn, an adult male in late July, an egg mass found on August 9th and a few 3d instar larvae taken in August.

The larvae in all varieties of the later corn, matured distinctly later on the average and showed no signs of developing a second brood, but prepared for winter about the middle of August and where not disturbed, would probably not move until spring. At harvest time about the last of August and in early September in a flint corn field showing 70% total loss, the estimated number of larvae per acre was 191,800. Of these 27% were within 12 inches of the ground and a four inch stubble carried 28,079 larvae, 6.82% of the larval population.

There was no movement of any import in the standing field corn in the fall, the distribution in the middle of October being practically the same as at the end of August. However, there is a noticeable movement outward and downward in the stalks in shock, but none of any importance from the shock to the ground and neighbouring stubble.

The date of sowing was closely correlated with the degree of infestation, the larval population and the total loss both in experimental and field conditions. In general, corn sown before May 24th was either practically ruined or suffered severe loss; that sown between May 24th and June 1st was heavily infested but suffered relatively less or but slight actual loss depending of course upon the type of corn; while the corn sown after June 1st, although in some cases showing a fairly high percentage of infestation carried few larvae and practically no loss except in the case of sweet corn. Thus on one farm of the three corn patches within 100 yards of each other, the sweet corn sown April 25th carried a larval population of 234,200 per acre with a loss of 100%; sweet corn planted June 1st developed an infestation of 75% and carried a larval population of 80,000 per acre with a loss of 20% while flint (smut nose yellow) planted May 22d, only carried 54,400 per acre, a stalk infestation of 67% and a total loss of not more than 10%. The sweet corn here doubtless protecting the flint by attracting a large number of the moths.

In the experimental plots the effect of the date of planting shows up most clearly, as can be seen in the tabulation below, though here the loss was slight and the larval population meagre, the corn all being planted after May 24th.

EFFECT OF DATE OF PLANTING ON INFESTATION

Variety Grown	Date	Per cent of stocks infested	Per cent of stocks broken over	Per cent of cobs infested
Golden Bantam sweet corn	May 24	30.18	16.93	16.9
	May 31	34.4	20.00	2.14
	June 3	15.33	7.66	1.89
	June 9	7.52	4.30	1.19
Dent Corn Early Leaming	May 31	24.30	69.44	.4
	June 3	13.45	1.50	.99
	June 9	8.11	1.62	1.17
Golden Glow	May 28	53.42	17.81	2.12
	June 3	21.08	9.73	.99
	June 9	7.44	4.65	.63
Wisconsin No. 1	May 28	55.44	16.14	2.65
	June 3	15.61	5.35	1.29
	June 9	3.66	2.44	1.16
Flint Corn Salzers' North Dakota	May 28	70.9	20.77	13.31
	June 3	10.62	10.12	3.77
	June 9	14.74	2.17	4.11
Compton's Early	May 28	82.4	50.00	10.47
	June 3	44.14	17.79	9.68
	June 9	15.10	4.17	3.45
Smut Nose Yellow	May 31	30.14	11.41	6.10
	June 3	28.57	14.29	4.11
	June 9	3.45	.86	1.89

The larval population in badly infested fields attained enormous magnitudes; a dent corn field sown May 18th carried an estimated total of 294,152 per acre, a flint field sown on the same day suffered a total loss of at least 65%, supported a total of 258,400 per acre and left when cut, in the stubble (less than 4 inches in height) and the crop refuse, a residue of 43,488 caterpillars going into the winter.

In general, all things considered, there seems to be no marked preference for any particular type or variety of corn. The severe loss associated with sweet corns and the flint varieties being due to the early planting, the ability of the larvae to establish themselves and the small dimension of the stalks. The obvious relatively slight loss in the dent corns being due to the later planting, its vastly greater bulk and its harder and coarser texture preventing a large proportion of the larvae establishing themselves in the first instar.

THE INFESTATION OF PLANTS OTHER THAN CORN

About the middle of July in the very severely infested fields of early sweet corn, to a less extent in severely infested flint and to a very slight extent in dent corn except in the one severely injured field, the nearly full grown and full grown larvae become restless. At this time large numbers of them leave the now breaking, shrivelling and drying corn stalks and carry on an apparently haphazard migration throughout a period of about two weeks. In the course of this migration as many as 24,400 larvae per acre found their way into the weeds in one field

of sweet corn sown April 25th. Others doubtless returned to the corn plants. Considerable feeding was done in the larger weeds, the pigweeds, the lamb's quarters and barnyard grass breaking over in a high percentage of cases. The barnyard grass was as high as 88% infested and in one instance a plant with 26 stems was found to contain 17 larvae. The weeds infested in this field in the order of frequency were: barnyard grass (*Echinochloa crus-galli*, Beauv.), redroot pigweed (*Amaranthus retroflexus* L.), yellow fox-tail (*Setaria glauca* Beauv.), lamb's quarters (*Chenopodium album* L.), tumble weed or Russian thistle (*Sal-sola* var. *tenuifolia*, G. F. W. Mey), green fox-tail (*Setaria viridis* Beauv.), lady's thumb (*Polygonum persicaria* L.), wild buckwheat (*Polygonum convolvulus* L.), ground cherry (*Physalis heterophylla* Nees); other weeds present but not infested were : purslane, Canada thistle, bitter sweet, milkweed and crab grass. However, throughout the district of the weeds found to be infested in additon to the above the following can be listed: orchard grass (*Dactylis glomerata* L.), Canada thistle (*Cirsium arvense* Scop.), wild sunflower (*Helianthus sp.*), blue weed or viper's bugloss (*Echium vulgare* L.), ragweed (*Ambrosia artemisiifolia* L.); mullein (*Verbascum thapsus* L.), goldenrod (*Solidago sp.*), old witchgrass (*Panicum capillare* L.), yarrow (*Achillea millefolium* L.), burdock (*Arctium minus* Bernh.)

In cultivated crops and flowers larvae have been secured in the field feeding in dahlia, geranium, aster, golden glow, beets, mangolds, tomatoes (fruit), beans, oats, squash vines, broom corn, Sudan grass, early amber sugar cane, Hungarian grass and Mann's Wonder sorghum.

No success was achieved in establishing larvae upon a long series of common weeds by attaching eggs laid upon a slip of corn leaf. The eggs hatched but the larvae rarely were able to infest the plant. In a series of experiments with paired adults caged over 35 common cultivated vegetables and flowers, the larvae in very small numbers established themselves upon mangolds, potatoes, celery, cauliflower, peas, beans, peppers, eggplant, radish (gone to seed), salvia and aster. Summing up, however, the entire infestation in the open of plants other than corn, with the exception of the dahlias, possibly barnyard grass and Mann's Wonder sorghum, was due entirely to the migrating larvae. These larvae particularly in the weeds together with those in the corn stalks, stubble and refuse have gone into the winter in very large numbers with every prospect of coming through successfully and giving rise to an increased infestation in 1922.

President Arthur Gibson: The next paper is by L. S. McLaine.

THE SPREAD OF EUROPEAN CORN BORER IN SOUTHERN ONTARIO

By L. S. McLaine, *Ottawa, Can.*

When the European Corn Borer was realized to be a serious pest, that is, in the summer of 1918, the Canada Department of Agriculture took steps to warn the general public of the danger of introducing this pest into Canada, and also carried on investigations to determine the amount of corn and other products likely to harbour the borer that had been imported into the Dominion from the infested districts in Massachusetts. As a result of these investigations scouting for the pest in the maritime provinces was carried on during the summer of 1919.

With the discovery of the insect in western New York in the fall of that year, the attention of the Department was directed to the possibility of the pest having spread into the province of Ontario. Some scouting was done in Welland county and along the Niagara River that fall, but was soon discontinued on account of the lateness of the season and the unfavourable climatic conditions. Plans were made, however, to resume the scouting in this territory the following summer.

On August 10th, 1920. the first infestation was found near Lorraine Station, Humberstone township, Welland county, Ont. The larvae were small in size and were collected in a field of ensilage corn. A preliminary survey of the infestation showed that it was exceedingly light, but widely scattered. On August 22d, a farmer living near St. Thomas, Ontario, submitted some samples of larvae found in his field corn and which were readily identified as caterpillars of the European Corn Borer. A prompt examination of this district showed the degree of infestation to be much greater than that in Welland county.

With the co-operation of the Ontario Department of Agriculture extensive scouting was started at once. The extent of the infestations exceeded by far anything that had been anticipated and as the season was advancing rapidly, the scouting had to be carried on at undue speed.

At the close of the scouting work it was found that there were two distinct infestations in southern Ontario, the first centering about Welland county, and the second centering about Middlesex and Elgin counties. During the scouting season one hundred and five townships in thirteen counties were examined, thirty-five of which were found infested by this insect. The area found infested covered approximately 2,780 square miles.

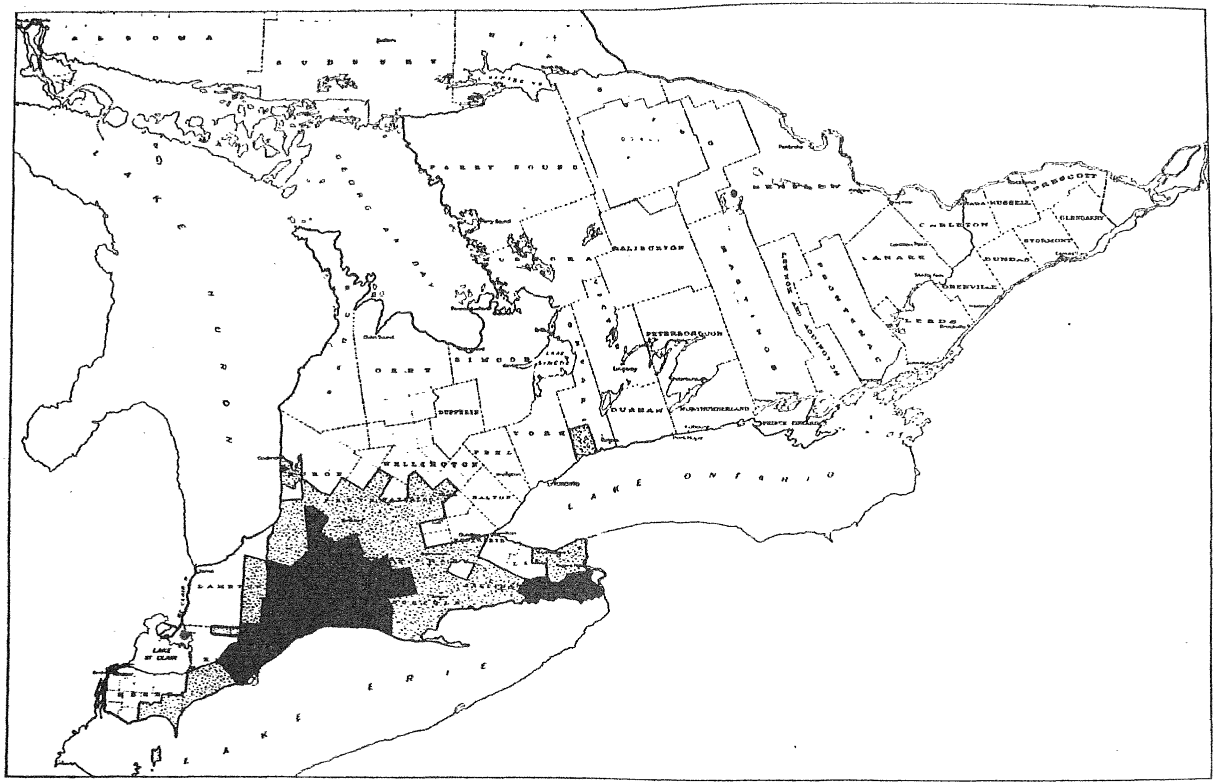


Fig. 7.—Map of Ontario showing the distribution of the European Corn Borer. Black indicates area infested in 1920 and gray the area infested in 1921(Original)

The season of 1921 was unusual in several respects, the continued hot dry weather in June and July caused all vegetation to develop with abnormal rapidity, and it was necessary to start the scouting work two weeks previously to the time originally planned. The scouting was actually started on August 1st and completed by October 3d. During this period one hundred and ninety-seven townships were scouted, of which sixty-five were found infested, these added to the thirty-five townships found infested in 1920 make a total of one hundred townships infested to date. The area found infested by the scouting this past season is approximately 4,910 square miles, which, in addition to the 2,780 square miles infested in 1920, makes a total of 7,690 square miles now infested by the European Corn Borer in this district.

The following townships in Ontario are infested at the present time: Oakland, Brantford, Burford, and Onondaga in the county of Brant; the seven townships in Elgin county; Gosfield South, Mersea and Pelee Island in Essex county; nine out of ten townships in Haldimand county, the tenth township was not scouted on account of the small amount of corn grown, but was included in the quarantine; Goderich, Hay, Stephen, Tuckersmith and Usborne in Huron county; Gore of Camden, Harwich, Howard, Orford, Raleigh, Romney, Tilbury East and Zone in Kent county; Brooke, Euphemia and Warwick in Lambton county; Clinton, Grantham, Louth and Niagara in Lincoln county; the fifteen townships in Middlesex county; the eight townships in Norfolk county; Pickering in Ontario county; the eleven townships in Oxford county; Blanshard, Downie, Easthope North, Easthope South, Ellice, Fullerton, Hibbert, Logan and Mornington in Perth county; Waterloo, Wilmot and Woolwich in Waterloo county; the eight townships in Welland county; Guelph in Wellington county; and Lancaster in Wentworth county.

The degree of infestation is heaviest in Elgin and Middlesex counties, and on the outer edges of the infested area borers were very hard to find.

It is also to be hoped that the past season was an unusually favourable one for the European corn borer, for there has been a general spread from practically all points of the 1920 area, but the most noticeable spread has been north, northeast and east.

The scouting work of 1920 showed that there were two distinct infestations in the province at that time, and the results of this past summer's work appear to bear out that conclusion. This season the scouts had no difficulty in making several collections of larvae in the townships adjacent to the western end of the old Welland infestation, and in townships adjacent to the eastern end of the Middlesex and

Elgin infestation, whereas great difficulty was encountered in locating borers in the center townships, that is, between the two infestations.

The infestation is exceedingly light on the extreme western edge of the infested area, that is, in Kent and Essex counties, in fact the only collections in the townships found infested in these counties this year, were taken along the main highway which runs east and west. The spread into this area may be due to artificial spread, either from carriers such as automobiles, or from infested corn refuse washed up on the shore of the lake, as the highway is adjacent to the lake in this district.

The discovery of the borer on the Lake Huron shore was made late in the season, and only a single collection of larvae was taken in the township of Goderich. As the neighboring township was found to be lightly infested, it appears as if the infestation in Goderich township may be due to an exceptionally long flight of the adult moths.

The only isolated infestation was found in Pickering township, about twenty miles east of Toronto and bordering Lake Ontario. The collection of larvae was made in the town of Pickering. Although the entire township, as well as the neighboring townships were carefully rescouted no further collections were taken. The nearest infestation to this point is in Linclon county approximately forty-five miles away.

Upon the completion of the scouting season in 1920, a domestic quarantine was placed on the infested area prohibiting the movement of corn stalks, broom corn, green sweet corn, roasting ears, corn on cob and corn cobs from the area placed under embargo. Exception was made however, to shipments of seed corn on the cob consigned to recognized fairs and exhibitions, which were inspected immediately upon arrival at destination. This quarantine was amended in May 1921, and three additional amendments were passed during the summer and early fall, quarantining the additional townships found infested.

In order to bring the attention of the general public to this embargo, warning notices were placed at the intersection of every road leading out of the quarantined area. In addition, large canvas banners, 2½ feet by 11 feet were stretched across the main automobile highways leading out of the district. Automobiles were stopped and searched on the main highways on Sundays and holidays for evasions of the quarantine. A careful watch was also kept on all markets and fall fairs. It was found that live stock men were in the habit of taking corn stalks as fodder for their live stock exhibitions at the larger shows, thus making it necessary to station inspectors at such fairs.

Although no direct evidence has been secured as to the origin of the outbreak of the European corn borer, this may have been due in Elgin and Middlesex counties to importations of broom corn from Europe. From correspondence, it has been learned that all Canadian broom manufacturers prefer to use broom corn grown on this continent, but in 1909-10 there was apparently a shortage of this product and one firm at least located in this district, imported large quantities of corn from Central Europe.

PRESIDENT ARTHUR GIBSON: The next paper is by Messrs. Crawford and Spencer.

THE EUROPEAN CORN BORER CONTROL MEASURES

Joint results of studies in 1921, of H. G. CRAWFORD, *Dominion Department of Entomology, Ottawa, Canada, and* G. J. SPENCER, *Ontario Agricultural College, Guelph, Canada.*

Complete control measures for the European Corn Borer in Canada have not as yet been perfected. Many facts have been worked out with regard to its life history, enabling us to outline certain practices which will go a long way towards keeping it in check in the districts where it is most prevalent. The question of limiting it to these areas will be discussed later.

We know of no means of destroying the European Corn Borer in the pupal, moth or egg stages. But since it spends about ten months of the year as a larva, it is in that stage that we can best bring about its destruction.

At harvest time the borer is full grown and may be found in all parts of the corn stalk except the leaves, from the tassel down to the tap root. Standing stubble or stubble plowed out and left on the surface with debris of all sizes, and corn stalks left in stooks or in standing sheaves or lying on the ground, constitute ideal quarters for borers to winter in, with remarkably low percentage of mortality.

Control: falls under two phases—

Phase 1. The destruction of the borer in the stems and cobs of corn.

Phase 2. The destruction of the borer in the stubble and refuse on the field after the crop has been removed.

PHASE I. *The destruction of the borer in the stem.* By cutting the corn as low and as early as is compatible with maturity, by far the largest proportion of borers in a field can be removed in the stems. The longer the stalks are left intact, the further down the borers will work and if all are not mature but are still feeding, the more damage they do. The

handling of the corn during harvesting operations will cause some borers to become restless and to leave the stalks. This is unavoidable.

A silo extension campaign should be strenuously waged.

The cutting box kills most of the borers; those that escape the knives are accounted for by the heat and the fermentation of the silage. A very few larvae in several inch-lengths of stalk, that have escaped the knives at filling time, walk up the sides of the silo and escape. Some escape from the stalks at cutting time, into the machine. Hens were observed to eat these greedily.

Where There is no Silo

In dealing with the stalks, the handling of corn for feeding as stover and of husking corn, presents the chief problem.

The removal of stalks from the field directly after harvest so as to allow of the *early plowing of the field, presents at present the greatest single difficulty in control measures.*

Farmers prefer to leave the stooks in the field until dry, rather than haul them to some other field or land, to dry sufficiently to allow of their being put into the barn without moulding.

We recommend the shredding where possible of all corn stalks used as fodder. This insures many of the borers being killed and the more complete eating of the corn by stock. The processs of shredding causes many larvae to leave their burrows and they then fall among the grain that shells out from the cobs. It was found that 80% of these were killed. When shredding is not practicable, the stalks after feeding and stalks used as bedding should not be thrown out into manure heaps as is usually done, but should be piled separately in an enclosure where the cattle cannot scatter them around, and should be burned. The fate of larvae in stalks trodden into ,manure and the effectiveness of this means of dealing with waste stalks, has not yet been completely worked out. It is still under investigation and observation.

Some farmers have been in the habit of burning waste stalks every week; they claim that it gives very little extra trouble. In any case the waste pile should be burned by the end of May, before pupation commences. If corn stalks are wet and are densely piled, the larvae leave the bottom layers early in spring and migrate to the upper three inches. Where the upper surface of the pile is dry, it can be readily burned over before June. In piles of dry stalks, the larvae do not migrate to the top and will pupate in their burrows from ground level right up through the mass and the moths will all emerge. In one case, it was found that all moths had emerged from a load of stalks 4 ft. 10 inches high, from

the very bottom of the pile. This pile being quite dry it burned completely to the ground.

Ears of corn that have been husked in the field should be hauled off with the stalks as soon after harvest as possible so as to allow of the early plowing of the field, and the waste husks should be burned.

Since this year's corn crop was so heavy (1920) several farmers in the infested districts, after filling and refilling their silos and selling what they could of the crop, burned all the rest of it in the field. Drastic measures, but very praiseworthy.

The stalks of sweet corn grown for factories should be cut after harvest, hauled off, fed and the remains treated as outlined—or if not used for feed, should be cut in the field with a mower, raked into windrows and, when thoroughly dry, burned. Some factories sell their corn stalks and cobs that were grown on contract; some ensile it as well as the cobs after being shelled at the factory, and sell the ensilage. This whole practice is to be recommended, since they may harbor larvae. Corn cobs after being shelled, should be burned (if not used as fuel) in the waste pile, rather than be left lying around the yard.

SECOND PHASE. "The destruction of larvae remaining in stubble and crop refuse in the field after the crop has been removed."

Stubble in any position and debris on the surface and weeds growing among corn, can and do harbor larvae.

In stubble we have found as high as 11000 to 14360 larvae per acre.

In debris we have found as high as 31000 larvae per acre.

In weeds we have found as high as 24000 larvae per acre.

Stubble left standing in the field or plowed out and left lying on the surface, constitutes almost ideal sheltering conditions for over wintering larvae. It has been found impracticable to dig or plow out stubble in order to pile and burn it.

Under conditions that existed in Ontario 1920 and in the fall of 1921, "we have found that *the plowing under to a depth of 6 inches, of stubble and debris, as early as possible after the removal of the crop is the factor of control second only in importance to the silo.* About the middle of September is the latest safe date for plowing to work, at Port Stanley, Ont. if the larvae are to be forced to leave the stubble in largest possible numbers.

The efficiency of plowing is in direct ratio to its earliness. By the end of October, the upward migration has ceased to be of much consequence and larvae in stubble and debris, plowed under at and after that date, will remain underground through the winter without suffering heavy mortality and migrate out before the last of April the following spring.

In dry sandy loam, bundles of stalks were buried with a larval expectation of at least fifty per bundle, and were taken and examined at intervals. The results follow:—

Date buried,	Sept. 4.					
Dates removed.	Sept. 20	Sept. 28	Oct. 12	Oct. 25	Nov. 2	Nov. 1.
	53	8	4	5	2	1 larvae.[3]

Plowing must be done thoroughly so as to cover all stubble and debris. This is materially helped by rolling immediately the crop is off, as rolling crushes open from 95% to 97% of the stubble, flattens down the stubble and weeds, kills some borers and destroys good wintering quarters for others, because it greatly facilitates moisture getting into the stalks and consequently, their earlier decay. Moreover, larvae leave moist soil sooner than dry soil. Under dry conditions, the whole season may be necessary to get all larvae in plowed under stubble, to come to the surface. Early plowing kills some borers but is chiefly of importance because it forces the vast majority of them to come to the surface. If any debris is around, they enter it.

On stubble land that has not been cleanly plowed down, rolling *after plowing* undoubtedly forces some outstanding stalks under the surface. Rolling of land that has been well and cleanly plowed, has been found undesirable because it delays the movement upwards, of the borers, and facilitates their migration to surrounding fields, when they do come up.

This movement upwards, of the larvae, is influenced by the type of soil in which infested material is buried, by temperature and by moisture. Just what these conditions are, has not been worked out yet. Reactions vary according to the time and consequently the *temperature* of the season.

Comparison of rates of larvae leaving various types of soil, in order of degree. Larvae used—at least 300 in each case.

Soils	*Larvae regained*	*Expectation*
1. Moist sand loam	29	300
2. Dry sand loam	41	
3. Wet clay	49	
4. Sand	54	
5. Dry sand loam (single layers)	72	
6. Dry clay	106	

In some experiments the larvae died in material that was buried early in August. In the majority of cases, however, *the earlier the plowing, the sooner the larvae emerged from the soil.* This shows that in August, larvae emerged rapidly and migrated to neighbouring fields.

In September especially on land plowed and sown to wheat, they did not migrate much to other fields, but simply disappeared. *Spring plowing* will kill a large number (how large a percentage is not known) but many mature. If spring plowing is done late, up to within a short time of pupation of the borers, the larvae will emerge after being plowed under. But if just ready to pupate, and then plowed down, they pupate in the stalks under ground and a high percentage of adults emerge from pupal cases, but none of them can reach the surface, from lower than 2 inches and the wings of the very few that do emerge are so battered that they cannot fly and soon perish.

The Futility of Individual isolated cases of cleaning up.

Unless a corn field is a long distance from other corn fields and is shut in by woods, the efforts of individual farmers to control the borer by thorough clean-up methods, are utterly futile. The movement must be community wide, if it is to succeed at all.

Late Planting. As has been pointed out, moths lay eggs most freely on the earliest sown and consequently the tallest, corn. Late planting of the main crop will undoubtedly reduce its degree of infestation. Some corn may have to be planted earlier to act as a catch crop, especially where very large acreages are grown in any one place in the infested regions. Trap crops *may* function if sown in fairly wide strips down one side of a field nearest to last years corn field. If this succeeds in attracting most of the infestation, it should be removed and fed at once and the waste parts burned when dry—or destroyed entirely if heavily infested, well before the main crop is harvested.

These control measures are not expensive to execute. Usually only one field on a farm is involved. Corn is such an important crop that the extra care necessary in thorough cleaning up operations will well repay time spent on them and any inconvenience involved.

Natural Control

NATURAL FACTORS IN THE CONTROL OF THE EUROPEAN CORN BORER.

1. Natural agencies, weather and winter, killed less than 3% of borers in winter 1920-1921.

2. In spring of 1920, the tachina fly, *Exorista nigripalpis* Town, accounted for so high as 13% larvae in one field with an average of 8% for that field. For the district an average of 3 or 4% would be fairly true. It cannot yet be considered of much consequence in control.

3. The insect that probably does more good than any other, is the spotted ladybird beetle, *Ceratomegilla fuscilabris* (*Megilla maculata*) which was repeatedly seen to eat every egg mass it found. These bee-

tles were kept in cages and were fed egg masses, which they consumed entirely. No Hymenopterous parasites were reared from larvae or eggs.

PRESIDENT ARTHUR GIBSON: The final paper in the series is by Mr. E. P. Felt.

THE EUROPEAN CORN BORER IN NEW YORK STATE[1]

By E. P. FELT, *State Entomologist, Albany, N. Y.*

The exceptionally severe and wide spread injury by the corn ear worm, *Chloridea obsoleta* Fabr., has been particularly unfortunate in that it has attracted general attention to a passing phenomenon and thus in considerable measure obscured a really serious problem.

It happens that the European Corn Borer, *Pyrausta nubilalis* Hubn., has as yet caused relatively little damage in New York State, though there has been appreciable injury to comparatively small plantings. The development of the last few years make it impossible to be certain as to the cause for this comparative immunity. The exceptionally thorough and general clean up in the eastern infested area in the spring of 1919 presumably had an important effect upon the abundance of the borers and even yet the pest is not numerous in that section, a fifteen per-cent stalk infestation being near the maximum. This work was on an exterminative basis, consequently no checks were left.

There was in the western part of New York State a thorough clean up during the fall of 1920 and the spring of 1921 by the Federal Government in the more badly infested section, centering on Silver Creek. Examinations and comparisons the past summer showed little difference between the cleaned up areas and the conditions on the nearby Indian Reservation where a forty per-cent stalk infestation was not difficult to find. There is no question but what the clean up destroyed hosts of borers. It is possible that climatic conditions were exceptionally favorable and enabled the few remaining insects to transform and deposit a maximum number of eggs and thus offset in considerable measure the beneficent results which should follow general clean up work. It has been suggested that the operations may have been nullified to a considerable extent by moths drifting from another badly infested area. This must be considered simply as a possibility and as yet not even the probability has been established.

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[1]Some of the data given in this paper have been secured by the writer in his capacity as Collaborator, Bureau of Entomology, U. S. Department of Agriculture.

The spread in New York State has been moderate, approximately a six mile extension on all boundaries, though the increase in the known infested area has been somewhat greater, due presumably to the difficulty of establishing the actual limits each season. There are now nearly 5000 square miles infested in New York State.

The similarity of conditions last summer in the infested areas of eastern and western New York and Ontario, Can., is further shown by the finding of the first pupa in the field at Scotia and Port Stanley May 30th, the first moths at Scotia and Silver Creek June 16th, an empty pupal case at Port Stanley on the same date, and the first egg mass at Scotia June 16th, at Silver Creek June 22d and at Port Stanley June 25th. Furthermore, in each of these localities, there was a partial, though very small, second generation.

The season of 1921 showed a marked increase in injury in the badly infested area in Ontario, and since climatic and agricultural conditions in that section and in eastern and western New York, particularly the latter, are very nearly identical, it may be that this development is prognostic for the New York areas. Here again, we are venturing into the realm of theory and this latter, when applied to the interpretation of conditions in eastern New York as compared with those in eastern Massachusetts has not always been entirely satisfactory.

It is certain that in portions of both the eastern and western infested areas in New York State, there are enough borers so that their progeny under exceptionally favorable conditions, such as appear to have obtained last year, might cause very serious losses, particularly to the early planted sweet and Flint corn. This is a possibility, which by some might be construed as a probability.

The close studies of the corn borer under New York conditions for the past three seasons have failed to show habitual breeding of this insect in any plant except corn and the occurrence of the borers in the stems of weeds, etc. has been restricted to plants in the near vicinity of corn. This relative freedom of other plants from infestation has been reflected in the modified quarantine recently promulgated and restricted in its application to corn, broom corn, all sorghums and sudan grass. There is ground for fearing a more general infestation following an increase in the relative number of the borers and should this occur, it would inevitably mean an extension of quarantine measures to other plants and in these latter there would probably be several important garden products.

It is obvious that national and state agencies cannot indefinitely continue to clean up the constantly increasing infested areas and it

therefore follows that repressive measures, which appear practicable to the farmer must be devised or serious losses may follow. The most promising of these were outlined at the somewhat recent Sandusky—St. Thomas conference and need not be discussed in this connection.

The corn ear worm situation and the relatively slight injury from European Corn Borer has resulted in comparatively little attention being given to the latter in New York State, in spite of its potential importance. It has seemed to the writer that conditions entirely justified the pointing out of the possibility, if not probability, of serious injury following a continuation of the corn borer conditions outlined above and the calling attention to the fact, that in the event of such developments, there would probably be a restoration and enforcement of the quarantine as originally promulgated. An effort is being made to interest the corn growers along these lines and in view of the fact that our badly infested corn, mostly the early planted corn, occupies a comparatively small proportion of the acreage, it seems entirely practicable and under present conditions desirable to emphasize the need of giving special attention to that part of the crop, though it would naturally follow that all corn fodder in infested areas would be worked up a little more carefully than has previously been the case.

A redeeming feature of the situation is found in the fact that infestation by the European Corn Borer is rarely uniform throughout the territory. There are marked variations. Many of these presumably can be explained by the difference between early and late planting and to some extent by variations in nearby sources of infestation. There is still great need of ascertaining the limitations of this insect under field conditions so that they may be used to advantage in ordinary farm practice.

Mr. T. J. Headlee: I would like to ask concerning control measures? If the individual farmer should practice the best combination of cultural methods that we have heard this afternoon, would he obtain freedom or approximate freedom the following year, though his neighbors did nothing to control the insect?

Mr. G. J. Spencer: I would say no. An investigation was conducted on a badly infested field last year. The field was gone over with a potato digger. It was also gone over with forks, and was handpicked, and yet the infestation this year was about the same as the previous year.

Mr. E. P. Felt: Was this in the badly infested area?

Mr. G. J. Spencer: Right in the middle of the badly infested area—right alongside of it.

There was one instance where it was effective. It may have been due to slightly later planting. It was an isolated field hedged in on two sides by woods, and this field infested last year was this year almost free, due I think to the lateness of planting; although the man did carry out an extensive cleanup campaign last fall.

MR. W. R. WALTON: I would like to ask Mr. Spencer if I may whether he finds that the physical condition of the soil affects migration of the larvae? Does he not find that migration is less in heavy soil than in light soil?

MR. G. J. SPENCER: I will refer that to Mr. Crawford.

MR. H. G. CRAWFORD: In connection with this point I might say that we carried out a series of experiments, burying ten stalks in loose bundles and single layers, at depths of six inches, throughout the season. The chief governing factor in the early season in the rate of larval emergence from various buried stalks was the moisture of the soil. They came up through very heavy clay soil to all practical purposes at the same rate of speed as they came up through sand. In fact, sand soil is the most retentive of larvae of any soil used in the experiments. Some of these experiments were put in between the fourth and the eleventh of September, so there was no temperature factor slowing them up in the sand at least during the first part of the season.

MR. W. R. WALTON: It seems curious that yours seem to be directly opposite to the results which we secured in similar experiments.

MR. H. G. CRAWFORD: In regard to the matter of control for the individual farmer—for effective results it has to be done on a community basis. However, there is the point to bear in mind that the early planted corn is very severely infested and ruined, in a case of sweet corn—one hundred per cent. loss. In the same vicinity the late planted corn, though fairly heavily infested, is not severely damaged, and the individual farmer could thus stop *severe* loss comparatively easily. In our efforts next year to get a group of the farmers to follow as many of our suggestions as possible, we are going to lay particular emphasis on putting corn in as late as is safe in the community. If they put it in as late as they feel, as practical growers, is safe, it will cut down the loss; though we will still be carrying infestations up to sixty, seventy and in some cases eighty per cent.

MR. E. P. FELT: Has Mr. Crawford any definite information, or an approximate idea of the relative area in the badly infested section, which was severely damaged by corn borer? I asked that question last fall. Has he an answer now?

MR. H. G. CRAWFORD: I have not. It would involve the study of every corn field involved, as one field will be less than twenty-five

per cent. *infested* and the next one will be sixty-five per cent. *loss*. This makes the determination of the general dollars and cents loss almost an impossibility unless one looks at them and canvasses every field oneself. An untrained man who has not really worked over a set of cobs and can tell the percentage of kernels involved and the stalk loss associated therewith, cannot give valid information. I am sorry, Dr. Felt, that it is impossible to give you the information.

PRESIDENT ARTHUR GIBSON: The next paper is by R. C. Treherne.

THE ONION MAGGOT IN BRITISH COLUMBIA UNDER IRRIGATED CONDITIONS

By R. C. TREHERNE, *Ottawa, Can.*

(Withdrawn for publication in the 52d Report of the Entomological Society of Ontario.)

PRESIDENT ARTHUR GIBSON: The next paper is by L. Caesar.

THE CABBAGE ROOT MAGGOT

By L. CAESAR, *Guelph, Canada*

(Withdrawn for publication in the 52d Report of the Entomological Society of Ontario.)

PRESIDENT ARTHUT GIBSON: The next paper is by Glenn W. Herrick.

THE LIFE HISTORY, HABITS AND INJURIES OF THE MAPLE CASE-BEARER

By GLENN W. HERRICK, *Ithaca, N. Y.*

(Withdrawn for publication elsewhere.)

PRESIDENT ARTHUR GIBSON: The next paper is by J. W. McColloch.

LONGEVITY OF THE LARVAL STAGE OF THE CADELLE[1]

By J. W. MCCOLLOCH, *Associate Entomologist, Kansas Agricultural Experiment Station*

The Cadelle (*Tenebroides mauritanicus* Linn.) in spite of its importance as a pest of stored grain and grain products has not been the subject of any extensive life history studies. Curtis[2] (p. 332) reports the rearing of a beetle by Kirkup from a Spanish almond. The larva lived fifteen months in addition to the period it had been in existence before its discovery and the beetle remained alive for 21 months.

[1]Contribution No. 72 from the Entomological Laboratory, Kansas State Agricultural College and Experiment Station.

[2]Curtis, John. 1883 Farm Insects. John Van Voorst, London.

Herrick[3] (p. 234) discusses the observations made by Slingerland, who reared this insect in wheat under insectary conditions. He found the egg stage to be about ten days and the larvae lived from August to the following April and May. He concludes from these observations that the life cycle is about one year. Slingerland also found the adults to be longlived, one beetle living nearly a year. Zvierezomb-Zubovsky [4] reared the Cadelle in flour and found it to have one generation a year. The egg stage varied from 7 to 24 days, the larval stage from 98 to 115 days, and the pupal stage frm 8 to 30 days. He states that adults emerging in the fall probably hibernate as do the larvae hatching late in the season. Throughout the most of the literature on economic entomology, this species is said to require one year for its life cycle. It is not the purpose of this paper to give an extended account of the life history, but rather to record certain observations, especially on the longevity of the larval stage. During the past few years the writer has had a number of Cadelle under observation and while the data are meager they are suggestive and indicate the need of a more extended study of this injurious species.

These studies were begun Sept. 7, 1916, when two larvae, each about one-eight of an inch in length, were found in a sack of seed corn. These were placed in separate one-half ounce tin salve boxes containing wheat and wheat bran for food and placed in the cave used for much of the life history work at the Kansas station.[5] One of these lived until July 30, 1918, and the other until August 23, 1919. This prolonged larval life was of such interest that it seemed advisable to obtain newly hatched larvae for futher work.

During July and August, 1918, several adults were placed in cages and 26 eggs were secured. These eggs hatched in from 15 to 18 days, and the larvae were placed in salve boxes as has been described. Ten of these larvae died during 1918, three in 1919, eight in 1920, and two in 1921. One larva is still alive at this writing (Dec. 15, 1921). In addition to these larvae, a number have been collected at various times and placed under observation.

As has been mentioned, the extended life of the larvae has been of special interest. In the case of the two worms collected Sept. 7, 1916,

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[3]Herrick, G. W. 1914. Insects Injurious to the Household and Annoying to Man. The Macmillan Co., New York.

[4]Zvierezomb-Zubovsky, O. 1919. On the Biology and Morphology of *Tenebroides mauritanicus* L. Report on the work of the Don Bureau for the Control of Pests of Agricultural Plants for 1918. Rostoff. Abstract in Rev. App. Ent., Vol. 8, Ser. A. pp. 107-108.

[5]McColloch, J. W. 1917. A Method for the Study of Underground Insects. Journ. Econ. Ent., 10: 183-187.

one lived 651 days and the other 1000 days. Of the twenty-six larvae which hatched from eggs, eleven lived an average of 822 days with extremes of 628 and 1248 days. One larva which hatched July 27, 1918, pupated July 16, 1920, giving a larval period of 720 days. Another one that hatched August 17, 1918, transformed July 12, 1921, having lived as a larva 1056 days. A number of worms collected in 1919 also lived two years or more.

The number of molts was determined in a few cases and in one instance in which the larva completed its growth, eleven molts were noted. Table 1 is presented to show the number and frequency of molts of several larvae and is typical of the others under observation. Zvierezomb-Zubovsky[6] records but five molts. He states that larvae molt about 27 to 31 days after hatching, the subsequent molts occuring at intervals of from 9 to 10, 10 to 14 and 20 to 24 days, respectively. About 22 to 27 days after the fourth molt the last skin is shed and the larva is ready to pupate.

TABLE I—SHOWING THE NUMBER AND FREQUENCY OF MOLTS OF CADELLE LARVAE

Larva No.	16.5008	18.1082	18.1092	19.1639	19.1641
Source	Collected Sept. 7, '16	Hatched July 27, '18	Hatched July 27, '18	Collected Oct. 27, '19	Collected Oct. 27, '19
Molts	Oct. 5, '16 July 27, '17 Sept. 14, '17 Sept. 19, '17 Oct. 17, '17 July 15, '18 Sept. 3, '18 Oct. 5, '18 June 25, '19	Sept. 30, '18 Oct. 12, '18 June 20, '19 Aug. 23, '19 Apr. 15, '20 July 23,' 20 Aug. 1, '21 Sept. 18, '21 Oct. 10, '21	Sept. 30, '18 Oct. 5, '18 June 20, '19 Aug. 2., '19 Nov. 11, '19 July 16, '20 Aug. 2, '20 July 2, '21 July 16, '21 Aug. 9, '21 Aug. 31, '21	June 25, '20 July 23, '20 Aug. 30, '20 June 3, '21 July 8, '21 July 25, '21 Aug. 12, '21 Aug. 25, '21 Aug. 29, '21 Sept. 26, '21	June 11, '20 June 25, '20 July 23, '20 Aug. 30, '20 June 9, '21 June 16, '21 July 25, '21 Sept. 9, '21 Sept. 30, '21
Remarks	Died	Still alive	Semi-pupa	Still alive	Died

Very little data were secured on the other stages probably because the proper conditions were not offered for pupation. The length of the prepupal stage was obtained in one case and occupied nine days. The pupal stage was determined in two instances and was found to be 12 and 13 days, respectively. The complete life cycle as found in one instance was 1085 days. Should the larva which hatched in 1918 and is still alive complete its development, the life cycle will be approximately four years.

The results of these observations open the question of whether the life cycle is normally one year, as stated in most of the economic literature of this species, or whether it is much longer. While the larvae were reared under conditions somewhat different than those occuring

[6]Op. Cit

in nature, yet the variation was hardly sufficient to cause this difference. The temperature conditions were in close accord with those encountered in many of the places infested by this insect. The food was the same as would be obtained in the ordinary farm granary except that other grain-infesting insects were not present. It is a well known fact that the Cadelle is also carnivorous, feeding on the various stages of other stored grain insects, and it may be that these are essential. The fact that many of the larvae lived two and three years, during which time they were feeding, growing, and molting would indicate that the rearing conditions were favorable. The high mortality after two or three years is probably due to unsuitable conditions for pupation. Herrick[7] (p. 233) records pupation occurring in pine boards, while others state that the larvae crawl into cracks and other sheltered places before transforming. Further experiments are now under way or soon to be started for the purpose of obtaining more data on the life economy of this insect and the factors which influence larval development.

MR. E. P. FELT: May I ask if these larvae were kept with a fairly good supply of food, or was it reduced to pretty near a minimum.

MR. J. W. MCCOLLOCH: They were confined in individual salve boxes filled with food, and this was changed frequently so that if they were feeding on grain alone they obtained plenty. They were usually given both wheat and bran in the same box, and in some cases some flour was added also, and in a few cases we tried to rear them entirely with flour and grain; but we got the best results with wheat and wheat bran.

MR. GLENN W. HERRICK: Do you give them much moisture?

MR. J. W. MCCOLLOCH: Fairly dry.

MR. GLENN W. HERRICK: I have a student carrying on experiments feeding these larvae, watching the gain and growth, and he finds that they desire a great deal of moisture.

MR. J. W. MCCOLLOCH: We have had this experiment going on for 3 or 4 years. In the last two years we have had very dry weather, and they lived in an open granary.

Adjournment: 5.00 p. m.

[7]Op. Cit.

THE STRAWBERRY WEEVIL CUTTING APPLE, TOMATO, AND COTTON BUDS IN TENNESSEE

By S. Marcovitch

Agricultural Experiment Station, Knoxville, Tennessee

The strawberry weevil, *Anthonomus signatus* Say, unlike its near relative, the cotton boll-weevil, is known to have several unrelated food plants: for example; the strawberry, blackberry, raspberry, and red-bud tree. It is probable, therefore, that its known list of food plants is not exhausted, particularly in more southern localities. After careful observations and breeding experiments, such was found to be the case.

On March 18, 1921, apple buds were examined at Curve, Lauderdale County, Tennessee, and found to have been severed. The cut buds remained on the tree, and were conspicuous by their smaller, shrivelled, appearance. In one cluster five out of seven buds were thus cut. When these aborted-looking buds were opened, eggs were easily found. A little later the adult weevils themselves were noticed on the twigs, and it was easy to see that they were responsible for the cut buds.

To make absolutely sure that no other insect was present, several buds were collected and placed in jars to rear the adults. On April 9, fullgrown larvae were present in the buds. Genuine strawberry weevils emerged from the buds on April 23. By breeding the adults from apple buds, we have practical proof of another food plant that may be credited to the strawberry weevil. The apple trees where the weevils were found are located close to a strawberry patch infested with weevils. Whether the strawberry weevil will continue to breed only in buds of apple trees that are adjacent to strawberry fields remains to be observed.

From conversation with farmers in West Tennessee, it was learned that cut buds were observed on cotton and tomato plants. Experiments were conducted with these plants to see if the strawberry weevil was capable of breeding in them also. On April 25, the newly emerged weevils from the apple buds were placed in a cage with a tomato plant. On May 2 several buds and flower pedicels were found girdled but none cut through. Upon examination, no eggs were observed. The buds were not cut straight across, as is usual, but girdled around the entire pedicel, causing the buds to wither. The strawberry weevil did exactly the same thing when placed in a cage with the common horse nettle, *Solanum carolinense* L., and with a cotton plant, on July 12. The squares of the latter that were girdled measured ¾ of an inch

or less across, and the pedicels about ½ of an inch. The cut squares were examined, but no eggs could be found.

This is in accord with observations made by the writer in Minnesota. There it was found that newly emerged weevils when given fresh buds would girdle them; but in no single instance could eggs be found. It was also learned upon dissection that recently emerged weevils do not contain eggs and are therefore unable to oviposit the same season. It should be noted that newly emerged weevils were used in the cages with the tomato plants. What effect old laying weevils would have on tomato and cotton buds has not been determined. The old weevils have probably all disappeared when cotton squares are put out in the field.

It may be of interest to report here some observations made on other food plants of the weevil that are already known. On March 18, 1921, the buds of the redbud tree, *Cercis canadensis*, were found cut in West Tennessee. The injured buds were smaller and shrivelled, as in the case of the apple, and contained eggs.

On April 29, 1920, the buds of the yellow-flowered cinquefoil, *Potentilla canadensis*, were observed to be severed at Knoxville. These contained eggs from which adults emerged June 2.

Wild blackberry buds were found cut May 4 at Knoxville. These were placed in a breeding jar and adults were obtained June 7.

On June 1, 1921, the weevils were reported to have destroyed practically all of the roses at Curve, Tennessee. Professor Sherman also records the weevil as breeding in and cutting the buds of the roses at Wallace, North Carolina, in 1904.

On April 16, 1920, adults of the strawberry weevil were found in the flowers of the common dogwood. When okra comes into flower, they may be found there too. Frost records the strawberry weevil in the flowers of *Vacciniums*, while Hamilton states that he found them in flowers of *Tilia* and *Rhus*.

With our present knowledge of the food habits of the strawberry weevil, it may be stated that certain plants are used for breeding purposes: namely, the strawberry, blackberry, dewberry, raspberry, yellow-flowered cinquefoil, redbud tree, rose, and apple. Other plants, like the tomato, horse nettle, and cotton, may have their buds cut, but no eggs deposited in them. Finally, the weevil may visit a great variety of plants, such as the dogwood, okra, blueberry, and sumach during their flowering period to obtain pollen.

Scientific Notes

Paradichlorobenzene Records. Report on 18,000 peach trees 6 to 20 years old in Berckmans Brothers Orchards, Mayfield, Hancock County, Georgia, treated with Paradichlorobenzol.

Applied	*Removed*
Oct. 11–14, 1921	Nov. 22–25, 1921

Examined 300 trees various ages and in all soils Nov. 22nd and 25th, 1921—2 live borers.

Examined 55 trees various ages and in all soils February 6, 1922, found 2 borers in 1 Hiley tree 10 yr. old, on red soil.

2 borers in 1 Belle, 7 yr. old, sandy loam soil.

1 borer in 1 Belle 10 yr. old, " " "

Labor for applying and removing paradichlorobenzol on 18,000 trees, $151.38. This is accurate and includes every item of expense of application and removal, but does not include cost of paradichlorobenzol, which was, including freight and hauling, $225.00.

A. L. Q.

The Dipterous Parasite of The Cottony Cushion Scale.—The synonymy of the dipterous parasite, *Cryptochaetum*, has been under discussion for some years and in order to settle the matter the writer collected a good series of individuals and forwarded them to Professor Aldrich for identification. His reply will straighten out the tangle.

"I cannot satisfy myself that *monophlebi* is anything but a synonym of *iceryae.* Both Skuse and Knab were misled by the figures accompanying Williston's first description. Williston had nothing to do with this figure and published afterward a corrected figure of the venation in his species. He distinctly stated that the wings were "short broad," which agrees with his figure published later, but not at all with the figure published in connection with his original description. So I believe you are justified in continuing to call your species *iceryae.*"

E. O. Essig

The European red mite. *Paratetranychus pilosus* Can. and Franz. has long been known in California as the citrus red spider, *Tetranychus citri* McGregor or more often as *T. mytilaspidis* Riley. It occurs in the southern part of the state as a pest both to citrus and deciduous fruit trees, while in the central and northern Coast Counties, it is chiefly a pest of such deciduous fruit trees as almond, apple, prune, peach, pear, cherry, etc. and passes the winter in the egg-stage on the same.

The mite has apparently been widely distributed throughout the country, since the eggs are so easily and obscurely carried on nursery stock, but it will probably not become a pest in all localities. Besides California it is recorded from the West in Oregon by Dr. H. E. Ewing and in Idaho by R. H. Smith.

Specimens of eggs and mites of the western form could not be distinguished from the European Red Mite by Dr. Philip Garman, who examined the material for us.

E. O. Essig

Nicodust composed of lime treated with 5% of the 40% Nicotine sulphate is proving very efficient in controlling young caterpillars, such as the leaf-rollers, tent-caterpillars and cankerworms, but must be used before the worms are half-grown.

E. O. Essig

The Foot Louse of Sheep. *Linognathus pedalis* Osborn, has been taken in the Sacramento Valley, California, a number of times during the past year and seems to be on the increase.

E. R. de Ong

Arsenate of Lead Spray for Plum Curculio Kills Grasshoppers. The large winged American Locust, *Schistocer a americana* Scud., has been very numerous in the peach belt of Georgia during the latter part of April, and considerable damage has been done by the feeding of this insect on small green peaches. In many orchards fruit on every tree could be found damaged by the feeding of this locust. In one orchard the damage was so severe that poisoned bran bait had to be resorted to. Most of the feeding was observed just prior to the third arsenate of lead treatment for the curculio. Observations made four days after the lead arsenate had been applied at the rate of four pounds of the powder to the two hundred gallon tank for the curculio showed that the treatment was also effective against these locusts. Many dead ones were found on the ground, and appendages of some that had been partially destroyed by ants were also observed. There was hardly a live locust to be found in these orchards after the arsenate of lead had been used.

Oliver I. Snapp, *Entomologist,*
U. S. Bureau of Entomology,
Fort Valley, Georgia

Mosaic and Curly Leaf Diseases of Sugar Beets.—In the September number of Phytopathology, pages 349–365, W. W. Robbins published an article entitled, "Mosaic Disease of Sugar Beets." A summary of his article follows: "1. Mosiac of sugar beet has become increasingly prevalent the last few years in steckling and seed beet fields of northern Colorado and western Nebraska. It also occurs in commercial beet fields near possible source of infection. 2. Mosiac of sugar beet is distinct from curly-top of sugar beet. 3. The principal symptom is mottling of the leaves, which may or may not be associated with their malformation. 4. Aphids carry the infectious principle. 5. Under greenhouse conditions, an incubation period on seed beets of approximately 24 days has been established; on seedling plants from 12–18 days. Thus far, evidence of seed transmission is lacking. 7. The virus retains its vitality in the steckling throughout the silo period. This is the only means of wintering-over thus far known."

In California, P. A. Boncquet described in Phytopathology VII, No. 4, pages 269–289, two types of diseases; namely, mottled leaf and black edge or black tip of sugar beets. These two types of diseases are symptoms and malformations of sugar beet mosaic, according to Robbins description and illustrations.

Evidence to support Robbin's view that sugar beet mosaic is distinct from curly leaf may be worthy of mention. Successive generations of non-infective beet leafhoppers (*Eutettix tenella* Baker) have been bred on mottled leaf, and black edge or black tip beets, and the hoppers were then transferred to healthy beets but not a single case of curly leaf developed. On the other hand, when infective leafhoppers were allowed to feed on mottled leaf and black edge or black tip beets, typical curly leaf symptoms appeared. It is evident, furthermore, that *Eutettix tenella* is not able to transmit mosiac of sugar beets.

Henry H. P. Severin, Ph.D.
California Agricultural Experiment Station

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The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, provided that at least 100 reprints be ordered at full price rates; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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The utility of large scale control work is likely to be tested in a most searching manner within the next few years, particularly in relation to the possibilities of checking the spread or controlling such insects as the Japanese beetle, the European Corn Borer and the Gipsy Moth. The first named presents an exceedingly difficult problem, since the adult is very resistant to poisons and flies readily while the subterranean grubs are nearly inaccessible. The European Corn Borer, although it was presumably brought into the country only about ten years ago, has become thoroughly established over considerable areas and here there may be almost unsuspected natural agents which have greatly facilitated the dissemination of the insect, not to mention the slow and practically inevitable spread due to what may be considered the normal flight of the insect. There is, furthermore, the gigantic problem of effectively preventing spread by artificial agencies along very extended lines of defense. The Gipsy Moth with its relatively slow increase now presents a condition somewhat analogous to that of the European Corn Borer in that the border line of the infested area has become greatly extended with indications of still greater expansion by normal spread, not to mention the danger of transportation by commercial agencies. There are obvious limits to artificial methods of checking dissemination and the same is true in a general way at least in relation to the size of areas over which broad scale, repressive measures can be conducted economically. Questions in relation to the control of these insects and also as to the value of different quarantine measures are becoming more insistent with the increase in infested areas and in the case of certain of the above mentioned species at least, there must soon be a determination of the practical limitations and modifications in policy to meet the changed conditions.

Book Reviews

Insects and Human Welfare. By CHARLES THOMAS BRUES, Harvard University Press, Cambridge, Mass., 1920.

The author states in the preface that "the present volume is an attempt to present some of the principles and practices of economic entomology in a form that will illustrate the biological relationships of insects to their environment." It contains five chapters, as follows:—Introduction; Insects and the Public Health; Insects and the Food Supply; Forest Insects; Household Insects; The Outlook for the Future. This interesting and attractive little volume contains 104 pages, 42 text figures, and is bound in red cloth. The addition of an index would have greatly increased its value as a reference work.

W. E. B.

Report of the Proceedings of the Fourth Entomological Meeting Held at Pusa, February 7-12, 1921. Edited by T. BAINBRIGGE FLETCHER, Imperial Entomologist, Government Printing Office, Calcutta, India, 1921.

The meeting reported was attended by over forty entomological workers from India and Ceylon, and fifty papers read at the meeting are included in this volume. Most of these papers (twenty-one) deal with crop pests, but there are eight on medical and veterinary entomology, nine on life histories and bionomics, four miscellaneous, two each on lac, and systematic entomology, one each on forest entomology, stored grain insects, and publications.

This report is an interesting and well printed volume of 401 pages with index, and LVII plates, eight of which are colored, and a frontispiece showing those in attendance at the meeting. It is bound in green board covers, with cloth back and corners, and is a valuable addition to the literature of Indian entomology.

W. E. B.

Annales des Epiphyties. Tome VII, Memoires et Rapports, en 1919 et 1920. MAURICE-MENDEL, Editeur, Libraire Speciale Agricole de l'Institut Agronomique, 58 Rue Claude-Bernard, Paris, 1921.

This publication of 461 pages, and many figures and plates which are not numbered consecutively, contains reports of researches and observations as follows:—Rapport phytopathologique pour les Années 1919–1920, par P. Marchal, Directeur de la Station Entomologique de Paris, et E. Foex, Directeur de la Station de Pathologie Végétale de Paris; Étude sur les Champignons Parasites, par G. Arnaud, Sous-Directeur de la Station de Pathologie de Paris; Le Criquet Marocain en Crau en 1920, par P. Vayssiére, Directeuradjoint de la Station Entomologique de Paris; Les Traitments Simultanés contre les Maladies Crytogamiques et les Insectes Parasitês des Arbres Fruitiers par les Bouillies Mixtes, par A. Paillot, Directeur de la Station Entomologique de Sud-Est; Essais de Bouillies Mixtes pour le Traitement des Arbes Fruitiers, par J. Feytaud, Directeur de la Station Entomologique de Bordeaux; La Fourmi d'Argentine, *Iridomyrmex humilis* var. *arrogans* Santschi,

dans le Midi de la France, par C. Chopard, Secrétaire de la Société Entomologique de France; Mission d'Études sur les Maladies de la Pomme de Terre en France, par MM. Quanjer et Foex; La Maladie de l'Enroulement de la Pomme de Terre, par Et. Foex, Directeur de la Station de Pathologie Végétale de Paris; Sur le Perfectionnement de la Pomme de Terre et sa Résistance aux Maladies, par J. Aumiot, Docteur es-sciences; La Maladie de l'Enroulement de la Pomme de Terre, par E. Blanchard, Directeur des Services Agricoles de Seine-et-Oise, et Cl. Perret, Directeur du Champ d'Expériences de Merle; Sur les Maladies des Pommes de Terre, par. Cl. Perret, Directeur du Champ d'Expériences de Merle; Les Maladies Cryptogamiques des Abricotiers dans la Vallée du Rhone, par J. Chifflot, Inspecteur Phytopathologique; Recherches sur l'Eudémis et la Cochylis dans le Bordelais en 1918 et 1919, par J. Feytaud;Les Insectes Nuisibles aux Cultures du Maroc, par Paul Vayssière; La Station Entomologique de Rouen, par Robert Régnier, Chef de Travaux de la Station de Rouen; Un Ennemi du Peuplier, *Idiocerus populi* Linn., ou Cicadelle du Peuplier, par Robert Régnier: La Question des Corbeaux en Normandie, par Robert Régnier; Observations Biologiques sur la Mouche des Olives et ses Parasites dans la Région de Menton, par R. Poutiers, Chef des Travaux, et L. Turinetti, Préparateur, à l'Insectarium de Menton; Recherches sur l'Emploi de la Chloropicrine comme Insecticide Agricole, Travaux effectués par P. Schindler, Ingénieur-Agronome, et par B. Trouvelot, Ingénieur -Agronome, Préparateur à la Station Entomologique de Paris, Rapport de B. Trouvelot; Les Maladies du Melon, par J. Dufrénoy, Ingénieur-Agronome; Rapports Sommaires sur les Travaux Accomplis dans les Laboratoires et Comptes Rendus des Missions d'Études: Laboratoires,—Station Entomologique de Paris et Insectarium de Menton,—Rapport de M. Paul Marchal, Directeur; Station de Pathologie Végétale de Paris.—Rapport de Et. Foex, Directeur; Station entomologique de Blois.—Rapport de M. L. Gaumont Chef des travaux; Station entomologique de Bordeaux.—Rapport de M. J. Feytaud, Directeur; Station entomologique de Montpellier.—Rapport de M. F. Picard, Directeur; Station entomologique de Saint-Genis-Laval.—Rapport de M. A. Paillot, Directeur; Station entomologique de Rouen.—Rapport de M. R. Régnier, Chef des travaux; Index.

W. E. B.

The Italian Pear Scale on Nursery Stock. The Italian pear scale, *Epidiaspis piricola* (Del Guercio), normally feeds on the bark of the trunk and limbs of the trees and hides under moss, lichens or scaly bark wherever the opportunity offers. In feeding it may cause small pits or depressions in the larger limbs, which may crack or become dead sunken areas, especially on old trees where the insect has occurred for many consecutive years. This scale is not widely distributed in California as an orchard pest, being largely confined to the Santa Clara Valley and adjacent territory, though it may be found in other parts of the state where it commonly attacks apple, prune and pear trees. Recently the scale was found on Myrobalan nursery stock at Gilroy. The attack was different from that on older trees in that the scales were found imbedded in the trunks of the seedlings just above the surface of the ground. In feeding they had caused large, deep, dimple-like depressions in the bark. At the bottom of each depression, and almost completely hidden, were from two to three scales. It may be said that these trees passed nursery inspection in two counties and such infested stock is an easy way to disseminate the pest because the scales are easily overlooked in the depressions.

J. F. Lamiman

Current Notes

Mr. A. F. Burgess visited Hartford, Conn., on April 6, for a conference on gipsy moth work.

Prof. Herbert Osborn visited Washington, D. C., the latter part of April, and stopped on the way at Harrisburg, Pa.

Dr. J. M. Swaine addressed the Biological Club, MacDonald College, on Friday evening, February 10, on "Forest Insect Injuries in Canadian Forests."

Mr. S. Willard Harman has been appointed research assistant in entomology at the Agricultural Experiment Station, Geneva, N. Y., vice Clarence R. Phipps, resigned.

Prof. J. A. Manter of the Connecticut Agricultural College, Storrs, Conn., has been in the Hartford Hospital nearly all winter receiving treatment for blood poisoning.

According to *Science*, Mrs. Anna Botsford Comstock, who retired in September from a professorship in entomology at Cornell University, has been nominated for election as alumni trustee.

According to *Science*, Dr. E. B. Poulton, Hope professor of zoology at Oxford, was elected president of the British Association of Economic Entomologists at the annual meeting, February 24.

Mr. J. D. Mitchell of Victoria, Texas, died February 27, 1922. He was an all round naturalist, and has been connected with the U. S. Bureau of Entomology since 1904.

Mr. W. M. Mingee, field assistant in insect control, employed on truck crop insect investigations since 1919, and stationed at Ocean Springs, Miss., has resigned to engage in business.

The corn borer laboratory of the Bureau of Entomology located at Scotia, N. Y., has been moved to 1120 Fifth St., Sandusky, Ohio. Mr. J. H. Harmon will be in charge.

Mr. George D. Smith of the Bureau of Entomology has resigned to accept the position of associate entomologist of the Florida State Plant Board. His headquarters will be at Madison.

The following transfers in the Bureau of Entomology have been announced: J. N. Tenhet, Clarksville, Tenn., to Quincy, Fla.; E. R. Van Leeuwen, camphor scale investigations to apple insect investigations at Medford, Ore.

Prof. W. C. O'Kane visited New York April 20th, in connection with the work of the Crop Protection Institute and stopped in New Haven for a few hours on his return.

The Pennsylvania Department of Agriculture announced that it would inaugurate on May 1st, a radio broadcasting service which will include timely advice on the control of insects and plant diseases.

Dr. L. O. Howard is the author of a chapter entitled "A Fifty-Year Sketch History of Medical Entomology," published in the Jubilee Volume of the American Public Health Association, "Half A Century of Public Health," issued last November. This article will be reprinted in one of the annual volumes of the Smithsonian Institution.

Mr. Clarence R. Phipps, assistant in entomological research, Agricultural Experiment Station, Geneva, N. Y., resigned January 1, 1922, to accept a similar position at the Missouri Fruit Experiment Station, Mountain Grove, Mo.

Mr. D. L. Van Dine, Bureau of Entomology, who has been engaged in investigations of malaria and mosquitoes at Mound, La., has resigned to accept, May 15, a position at the Pennsylvania State College.

Mr. Arthur Gibson, Dominion Entomologist of Canada, has recently been elected a Fellow of the Royal Society of Canada. He is also treasurer of the John Macoun Memorial Committee of the Ottawa Field Naturalists' Club.

The field laboratory of the Bureau of Entomology at Carlisle, Pa., has been moved from 227 Moreland Avenue to the Kronenberg Building on Hanover Street. Mr. P. R. Myers will continue in charge.

Mr. J. J. McNeil, who has been in charge of the auditing and accounting work of the Federal Insecticide and Fungicide Board, resigned April 24, to accept a position in the Fruit Growers Express Co.

Dr. J. D. Tothill of the Canadian Entomological Branch, spent a part of February in Boston, visiting the Corn Borer and Gipsy Moth Laboratories with particular reference to the natural control of these insects.

Mr. R. P. Gorham of the Canadian Entomological Branch has completed the index for the third volume of the report of the Canadian Arctic Expedition, which deals with the insects collected on the trip.

Mr. H. J. Dodd has been appointed field assistant in the Bureau of Entomology, and assigned to duty at Fort Valley, Ga., on life history studies of the plum curculio and other peach insects.

Mr. E. R. Selkregg of the Bureau of Entomology, who has been in charge of life history work in connection with the peach insect investigations at Fort Valley, Ga., has resigned to enter commercial work.

Dr. Vernon L. Kellogg of the National Research Council was scheduled to speak on "The Power and Importance of Man" at the reception of the American Philosophical Society on Friday evening, April 21, in Philadelphia.

The Bureau of Entomology has established a new laboratory at Sligo, Md., where especial attention will be given to the subject of insecticides and biological studies of fruit insects. Mr. E. H. Siegler is in charge.

According to *Science*, on March 2, Prof. H. M. Lefroy delivered the first of two lectures at the Royal Institution on (I) "The Menace of the Insect Pest," and (II) "The Balance of Life in Relation to Insect Pest Control."

The entomological department of the Ohio Station has established a laboratory at Chillocothe, with Mr. A. E. Miller in charge. Particular attention will be given to insects attacking truck crops. Prof. H. A. Gossard visited the site on April 4.

Mr. Reginald Hart, an entomologist of experience with tropical insects and formerly connected with the Bureau of Plant Sanitation of Cuba, is now a member of the staff of the Florida State Plant Board, with headquarters at Gainesville.

Mr. C. E. Smith of the Bureau of Entomology, in charge of the Baton Rouge, La., Station, is conducting experiments to control red spider on strawberries at Hammond, La., where in spite of continued heavy rains, a serious infestation is reported.

Dr. F. C. Craighead of the Canadian Entomological Branch, returned on March 25 from Washington, D. C., where he studied the larval stages of the Cerambycidae. On the way he stopped at Harrisburg, Pa., to examine material in the State collection there.

Dr. W. J. Holland, Director of the Carnegie Museum, Pittsburgh, Pa., was elected on March 9 as one of the honorary members of the Entomological Society of Brazil, "in token of their appreciation of the services he has rendered to the science of Entomology."

Dr. L. O. Howard left Washington D. C., Sunday, May 14, for a six-weeks' trip to visit the field stations of the Bureau of Entomology throughout the western states, with particular attention to the field stations for the study of forest insects.

Dr. Thomas Algernon Chapman died at Reigate, Surrey, England, December 17, 1921, in his 78th year. He was a Fellow, and many times Vice-President of the Entomological Society of London, and published a number of papers on Lepidoptera, Coleptera, Diptera and Hymenoptera.

Dr. W. M. Mann of the Bureau of Entomology, who was a member of the Mulford Expedition to South America, arrived in New York April 13, with a large collection of insects and a number of mammals and ethnological specimens which will be placed in the U. S. National Museum.

The officers of the Florida Entomological Society for 1922 are as follows: President, Frank Stirling; Vice-President, Dr. O. F. Burger; Secretary, A. H. Beyer; Treasurer and Business Manager of *Entomologist*, F. M. O'Bryne; Member of Executive Committee, Dr. J. H. Montgomery; Editor of *Entomologist*, Prof. J. R. Watson; Associate Editor of *Entomologist*, Dr. Wilmon Newell.

Prof. E. H. Strickland left Ottawa on February 25 to take up his new duties at the University of Alberta, Edmonton, and on his way spent a month at Amherst, Mass., on systematic work and investigating the methods of teaching economic entomology. He also spent a few day in Boston and New York.

Dr. A. D. Hopkins of the Bureau of Entomology gave an address April 11, on "Insect Depredations in the Maine Woods," before the American Paper and Pulp Association at the Waldorf Astoria, in New York. He dwelt especially on the outbreak of spruce bud worm in the New England States and Canada, which is just now causing considerable concern.

An extensive outbreak of *Dendroctonus* in spruce was reported some time ago from the Porcupine Forest Reserve in northern Saskatchewan. The affected area was cruised by the Forestry Branch and the reports indicate that the injury is severe. The outbreak is probably caused by the same species of beetle which is affecting the spruce in the Gaspe Peninsula.

Mr. J. E. Graf of the Bureau of Entomology in charge of field control of Mexican bean beetle, is visiting Mountain Air and other points in New Mexico, to secure data on the hibernation of this beetle in the Rocky Mountain plateau regions. In the Estancia Valley the Mexican bean beetle caused a loss in 1921, which has been estimated at $100,000.00.

Mr. E. P. Felt, at the request of the Entomological Club of Madison, Wis., gave a radio phone lecture on April 24, at 9 o'clock P. M., Eastern Standard Time, on the subject of "Bugs and Antennae." This lecture was broadcasted from the sending station of the General Electric Company, Schenectady, N. Y., and was heard by a number of entomologists in the eastern states.

Mr. H. G. Crawford of the Canadian Entomological Branch addressed the Lambton County Corn Growers on the subject of the European Corn Borer about the middle of February. On March 6, he returned from his annual leave of absence, having spent several days at the U. S. Corn Borer Laboratory, Arlington, Mass., in consultation with Mr. Caffrey and other members of the staff.

According to *Science*, the Board of Regents of the University of Minnesota have granted Prof. F. L. Washburn, of the division of entomology and zoology, a six months' sabbatical furlough to collect insects in certain islands of Polynesia, especially Tahiti, Murea, and probably the Marquesan and Cook groups. The expenses are provided for through private funds furnished by business and professional men of Minneapolis, and the collections will become the property of the University.

Entomological News for May contains an obituary notice of Dr. Joseph Lane Hancock, who died in Chicago March 12, 1922. He was born in Chicago, April 12, 1864, and though he distinguished himself as artist, author and physician he was also a naturalist, and published many papers on the Orthoptera. His collection was an extensive one and has been purchased and is now a part of the Morgan Hebard collection deposited at the Academy of Natural Sciences, Philadelphia.

The following recent appointments in the Bureau of Entomology are announced: Maurice E. Phillips, a graduate of the University of West Virginia who recently received his M. S. degree from Cornell University, has been appointed junior entomologist to investigate insects attacking dried fruits and vegetables, Fresno, Calif; H. A. Jaynes, a graduate of the Connecticut Agricultural College, junior entomologist, assigned to Japanese beetle project, Riverton, N. J.; J. A. Harris, a graduate of the Mississippi Agricultural College, field assistant, assigned to plum curculio and other peach insect investigations, Fort Valley, Ga.; H. H. Link, formerly employed in the Bureau, field assistant, citrus fruit insect investigations, Orlando, Fla.

Mr. E. G. Smyth, formerly chief entomologist of Porto Rico, and connected with the Bureau of Entomology as entomological assistant from 1908 to 1913, as extension entomologist from 1917 to 1918, and as collaborator during 1921, has been appointed as special field agent to undertake a trip to southern Mexico with the hope of discovering parasites of the Mexican bean beetle suitable for importation into the United States. Mr. Smyth will proceed by way of Birmingham, where he will stop over for consultation with Bureau employees, and thence to Mexico by rail, where six months will be spent in investigations of the Mexican bean beetle and related types with particular reference to parasites and factors affecting the economic importance of this pest in its native habitat.

A regional conference of Canadian and American entomologists was held April 12 and 13 at Minot, N. D., where a full discussion of the international phases of the investigations of the pale western cutworm, grasshopper problems, and the western wheat-stem sawfly was had. As a result of this conference, it was decided to conduct a series of experiments, both in Canada and the United States, on a uniform basis, so as to render the results easily comparable. It was also decided to construct an international map, including in this several of the northwestern States in the United States as well as those Canadian provinces which are most seriously involved in grasshopper outbreaks. The purpose of the map is to record and visualize grasshopper conditions in a large, regional way and to form a basis for annual records of such conditions from year to year. Those attending the conference were: Norman Criddle and A. V. Mitchener of Manitoba, H. L. Seamans of Alberta; M. P. Tullis, field crop commissioner for Regina, Saskatchewan; A. L. Strand, representing Montana; Prof. A. G. Ruggles, representing Minnesota; Prof. R. L. Webster of North Dakota; and W. R. Walton, Stewart Lockwood, Alfred Eastgate, and C. N. Ainslie, of the Bureau of Entomology. It was decided to attempt to hold a similar conference in Winnipeg about the same time next year, as the results of the conference were considered to be of the utmost value. The title adopted by this group is "International Northeastern Committee on Insect Pests."

Horticultural Inspection Notes

An office has been secured in the Customs Examining Warehouse, Toronto, for the inspector in charge of the Toronto district.

Canadian Quarantine No. 2 dealing with the European Corn Borer, was passed on February 10th; this revision brings the quarantine up to date, and places a double quarantine on the counties of Elgin and Middlesex.

A conference of southern state inspection and transportation officials, nurserymen, and representatives of growers' organizations has been called for at Atlanta, Georgia, on May 30 and 31, for the purpose of considering uniformity of inspection practices in the southern states.

On February 7th, amendment No. 13 to the Canadian Regulations under the Destructive Insect and Pest Act was passed, which added a list of injurious insects, such as the Japanese Beetle, Mexican Bean Beetle, etc., to Section 18 of the Regulations.

A colored map showing the area quarantined for the European Corn Borer has been prepared by the Natural Resources Intelligence Branch of the Canadian Department of the Interior, and has been distributed to all the transportation companies, corn growers, etc., in the quarantined district.

Information has just been received to the effect that Dr. Paul Marchal, who for years has been the Chief Phytopathological Inspector of France, has resigned. His successor has apparently not been appointed, but all communications should be addressed to Monsieur le Ministre de l'Agriculture, (Service phytopathologique), 78, rue de Varenne, Paris, VII.

Mr. R. Owen Wahl, Entomologist and Zoologist of the School of Agriculture, Middleburg (Cape), South Africa, has for several weeks been visiting the various ports of entry at which inspectors of the Federal Horticultural Board are stationed, for the purpose of studying the methods and procedure followed in port inspection, fumigation, and sterilization work.

Interesting interceptions made at the port of New York during the months of March and April included the Papaya fruit fly (*Toxotrypana curvicauda* Gerst) in mango fruit from Jamaica, the woolly white fly (*Aleurothrixus howardi* Q.) on banana leaves from Porto Rico by Inspector Emile Kostal, and *Aleurothrixus floccosus* on citrus leaves from Porto Rico by Inspector R. G. Cogswell.

As a result of the arrival of shipments under special permit, at Washington, D. C., during the early spring months, it was necessary to take on two additional inspectors to assist in the examination of this plant material. Inspectors J. L. Bottimer and W. E. Conn, who are engaged in the Clean-Up Work under the direction of Dr. W. D. Hunter, were temporarily transferred to Washington.

Apple stock from Czecho-Slovakia arriving at the Inspection Office in Washington in April, proved to be infested with the Apple Stem Piercer, *Magdalis barbicornis* (Latr.). The insects at the time of arrival, were for the most part in the pupal stage, although adults appeared within a short period. This weevil in Europe is reported to attack, in addition to apple, quince and medlar trees.

On March 28, Inspector U. C. Zelluff, stationed at Tampa, Florida, discovered a passenger leaving a steamship arriving from Havana, with four potted avocado trees. Upon inspection, these trees were found to be infested with the Citrus Black Fly. This appears to be a flagrant attempt on the part of a Florida resident to

violate the provisions of the Plant Quarantine Act of 1912, since a permit to import plants had not been requested.

Mr. George M. List of Colorado reports that a florist of Loveland, Colorado, recently experienced the entire loss of his Easter Lilies due to an attack of the Bulb Mite (*Rhizoglyphus hyacinthi*). A relatively small percentage of the infested plants developed blossoms, and many of the plants were entirely destroyed. The Bulb Mite is constantly being intercepted on introduced bulbs, and it is almost safe to assume that every large shipment of European bulbs is infested by this mite to a greater or less extent.

A recent shipment of broom corn infested with the European Corn Borer arrived in New York from Hungary. A careful examination was made of a representative number of bales, and it was determined that not more than one per cent. of the stalks was infested with the larvae of this insect. The shipment was promptly sterilized with live steam at the plant of the Pan-American Fumigating Company at Brooklyn, New York, under the direct supervision of Inspectors L. C. Griffith and H. G. Frank of the Federal Horticultural Board.

The Citrus Black Fly continues to be collected on foliage arriving at Key West. Inspectors L. R. Warner, W. V. Millington, and J. V. Gist of the Florida State Plant Board made interceptions in the months of January, February and March. To illustrate the thoroughness with which these men are performing their work, one of the interceptions consisted of the finding of egg spirals on leaves attached to a jasmine sprig which was pinned on the fur of a woman's coat. The same insect has been collected by Mr. Merle R. Brown, also of the Florida State Plant Board, on sapodillas arriving at Miami, Florida, from Nassau.

The conference which was held by the Federal Horticultural Board in Washington on May 15, was well attended. Delegates representing florists, nurserymen, growers, importers, and amateurs were present, as were officials from the following foreign countries: France, Jacques Courtine, Bulb Growers and Exporters Syndicate of Toulon; Belgium, Charles Pynaert, President, Chamber of Horticulture, and Louis Sander of Sander and Fils, Horticulturists; Holland, N. van Poeteren, Chief, Phytopathological Service, and E. van Slgteren, Phytopathologist for the Bulb District of Holland; England, W. G. Lobjort, Comptroller of Horticulture. Officials from the following states were in attendance and took part in the discussion: California, Texas, Florida, Georgia, Michigan, Maryland, Pennsylvania, New Jersey, Alabama, and Connecticut.

Mr. H. F. Dietz of Indiana reports that there are two rose diseases causing considerable damage in the State of Indiana at the present time; namely, cane blight (*Coniothyrium fuckelii*) and crown gall. The former has been especially troublesome over a period of at least two years. Mr. Dietz is of the opinion that the disease gains entrance to the plants through the pruning wounds and may possibly be spread by infected shears or knives. In young and vigorous plants, the disease usually stops at the first node, forming a canker. Plants over two years of age which have been weakened as a result of forcing, are apparently more seriously affected, the disease occasionally killing long canes and at times the entire plant. Crown gall is especially troublesome on the varieties Ophelia and Sawyer grown on their own roots. Affected plants do not give good results when forced, nor do they yield readily to cultural treatment.

On March 21st, the following regulations to the Canadian Destructive Insect and Pest Act were passed: Amendment No. 14. Prohibiting the importation of currants and gooseberries from all countries, except from the State of New York into

the province of Ontario. Amendment No. 15. Prohibiting the importation of certain plant products from those areas in the United States infested by the European Corn Borer, unless the same are accompanied by a certificate of inspection. Amendment No. 16. Prohibiting the importation of potatoes from the countries mentioned under subsection (a) of section 7 of the regulations, as well as from the states of Pennsylvania and West Virginia on account of the potato wart disease. Amendment No. 17. Prohibiting the importation of alfalfa hay from those areas in the United States infested with Alfalfa Weevil. Amendments number 14 and 16 were passed upon the recommendation of the Division of Botany and will be administered in co-operation with that Division.

It has been determined as a result of the inspection of express, mail, and freight shipments containing nursery stock from various states by Messrs. L. L. Spessard and H. L. Sanford, inspectors of the Federal Horticultural Board located in Washington, D. C., that a number of the nurserymen have been making it a practice to utilize invalid certificates, some of which are a year or more out of date, others which do not indicate the date on which the certificate becomes invalid, and in many instances, certificates which have been corrected. These irregularities have been brought to the attention of the various state officials responsible for the certification of the plant material in question. The above applies to practically every state forwarding plants in any numbers to Washington, and it is therefore probably safe to assume that invalid certificates are being used in a very large percentage of the states. This is a matter which should receive the attention of all state officials certifying stock for distribution.

Figures recently compiled indicate that 97 foreign shipments of plants have been found to be infested with one or more nests of the Brown-Tail Moth from August 20, 1912 up to and including April 22, 1922. These interceptions were as follows: France 95 (Apple 27, Cherry 9, *Crataegus* sp. 1, *Crataegus oxyacantha* 1, *Crataegus flora* 1, *Cydonia oblonga* 10, Fruit stocks 14, Pear 11, Purple barberry 1, Cotoneaster 2, *Fagus sylvatica* 1, Rose 6, Plum 3, *Pinus mughus* 1, *Prunus pissardi* 1, *Sorbus aucuparia* 1, Unknown plant 5); Holland 1 (Fruit seedling 1); Ireland 1 (Rose 1). The number of species of insects and plant diseases intercepted on introduced plants from the eight principal exporting countries from August 20, 1912 up to and including April 22, 1922, follows: Belgium—Insects 73, Plant Diseases 18; England—Insects 104, Plant Diseases 4; France—Insects 153, Plant Diseases 17; Germany—Insects 25, Plant Diseases 4; Holland—Insects 167, Plant Diseases 31; Ireland—Insects 21, Plant Diseases 0; Japan—Insects 214, Plant Diseases 29; Scotland—Insects 14, Plant Diseases 0.

Two Mealy Bugs Found in Ant's Nests. *Pseudococcus longisetosus* Ferris. This mealy bug was first found associated with ants in San Mateo County, California by Mr. Ferris of Stanford University who described it as a new species. He also found it near Stanford University on the underground stems of *Castilleia foliolosa*, and *Orobanche tuberosa* and from the roots of *Armeria vulgaris* near Pacific Grove. The writer recently found this mealy bug associated with ants on roots of Poison Oak, (*Rhus diversiloba*) in Niles Canyon.

Phenacoccus colemani Ehrh. was described from *Rubus* sp., near Palo Alto, California and has been found associated with ants near Stanford University. Dr. E. C. Van Dyke found this species associated with ants near Redwood Peak, Alameda County. The writer found the same mealy bug on Cypress Ridge, Marin County, where it was associated with ants under rocks and feeding on grass roots.

J. F. Lamiman

Apicultural Notes

The East Tennessee Beekeepers' Association now has 111 members and will hold its fifth annual convention at Knoxville on May 17.

The black locust blossom has been abundant in Tennsesee. White clover is beginning to blossom on May 9. Bees generally are doing well.

It is reported that 62 students are enrolled in the course in beekeeping at the Colorado Agricultural College at Fort Collins, Colo.

Dr. E. F. Phillips of the Bureau of Entomology has recently been elected an honorary member of the Beekeepers' Association of South Africa, and honorary vice-president and Fellow of the Apis Club, an international organization with headquarters in Benson, Oxon, England.

Mr. W. L. Walling, who has been spending the winter in Knoxville, Tenn., and giving several lectures to the apicultural classes of the University of Tennessee, has returned to his beeyard at Hardin, Montana. Last year Mr. Walling produced 18,500 pounds of honey.

Dr. G. F. White, specialist in insect diseases, Bureau of Entomology, has been elected a Fellow of the Apis Club, Benson, Oxon, England. In transmitting the notice of election, the secretary said "It is the highest position of distinction that is within our power to offer to a benefactor in beekeeping."

A series of beekeepers' meetings was held at Jackson, Lexington, Dyersburg and Memphis, Tennessee, on April 25, 26, 27 and 28 respectively. Much interest was shown in these meetings by the beekeepers who have asked that a West Tennessee Beekeepers' Association be perfected at the next meeting of the Farmers' Institute to be held at Jackson.

Prof. R. O. Wahl, entomologist of the Grootfontein Agricultural School, Middleburg, Cape Colony, South Africa, has recently made a trip through Canada and the United States. He visited Ottawa April 5 and 6, and spent the 24th and 25th at the Ohio Station, Wooster, Ohio. He spent a week at Medina, Ohio, to study American beekeeping methods and equipment. He is a friend and co-worker of C. W. Mally who was assistant entomologist at the Ohio Station from 1898–1902. After leaving the United States, Prof. Wahl expects to visit Honolulu and Australia.

Following the conference held in Washingtom March 9th, a bill was drafted prohibiting the importation of adult bees into the United States except for scientific purposes by the U. S. Department of Agriculture, and except from countries having no diseases dangerous to adult bees under rules and regulations prescribed by the Secretary of the Treasury and the Secretary of Agriculture. This bill was introduced into both Houses of Congress and at the time of this writing has been unanimously reported on favorably by the House Committee on Agriculture. The bill seems to have met with almost universal favor among beekeepers, the only opposition having come from those interested in future importations of races other than the Italian. The Minister of Agriculture of the Dominion of Canada has issued an order prohibiting the importation of bees from Europe and the Dominion of Australia has a similar order applying only against Great Britain. Both are, of course, designed to prevent the introduction of the Isle of Wight disease into these countries. The March number of Schweizerischer Bienenzeitung announces the finding of the mite causing the Isle of Wight disease in Switzerland.

The annual meeting of the Connecticut Beekeepers' Association was held at the Capitol, Hartford, April 29. About 125 were present. The following officers were reelected: President, Henry L. Lankton, Wethersfield; Secretary and Treasurer, Louis St. Clair Burr, South Manchester.

Beekeeping seminars are held regularly on the second and fourth Friday evenings of each month at the Bee Culture Laboratory, Somerset, Maryland. Visiting entomologists and beekeepers are welcome. The following subjects have been discussed in these seminars since they were instituted: E. F. Phillips, Digestion of Carbohydrates by the Honeybee; A. P. Sturtevant, Hydrogen-ion Concentration; R. E. Snodgrass, Metamorphosis in Insects; W. J. Nolan, Brood-rearing during the Season; E. L. Sechrist, Tropical Beekeeping; P. B. Dunbar, The Food and Drugs Act.

Pacific Slope Notes

E. O. Essig will take a group of entomological students of the University of California for a six weeks' stay in the Santa Clara and Pajaro Valleys where a practical study of orchard and field insects will be made during the summer.

Mr. John Lamiman who graduates in entomology at the University of California this year, has been appointed a member of the entomological staff to investigate orchard insects with particular reference to codling moth and peach borer.

Mr. C. T. Dodds, a graduate student in Entomology at the University of California, will spend the summer in Mexico assisting Mr. Zwalenburg in the introduction and rearing of parasites to control the sugar cane borer. He expects to continue his work at the University in the fall.

Mr. Claude Wakeland, formerly extension entomologist of Idaho, has been appointed Experiment Station Entomologist, University of Idaho, with temporary headquarters at Rexburg, Idaho, and Mr. Don B. Whelan succeeds Mr. Wakeland as extension entomologist at the University.

In a recent letter received by Professor Herms from Professor C. W. Woodworth now in Nanking, China, there are many items of interest, among them the news that he has organized a fly and mosquito campaign for that city and has been made a special member of the Police Department and has a special office in the Yamer of the Chief. Professor Woodworth has also had constructed a boat laboratory 48 feet long and 11 feet wide, naming it the "Dragonfly," and the twenty horsepower motor launch used to tow the same, is named the "Cicada." His organization of the Kiangsu Province Bureau of Entomology is evidently progressing satisfactorily.

Notes on Medical Entomology

According to *Science*, Sir Ronald Ross has been elected a member of the Athenaeum Club for "distinguished eminence in science."

Sir Patrick Manson distinguished for his work on malaria and tropical diseases, died on April 8, at the age of 76 years.

Dr. Seymour Hadwen, chief veterinarian and parasitologist of the U.S. Biological Survey, who has just completed an eighteen month's study of reindeer in Alaska, sailed for England April 16, to continue his studies.

Mr. G. F. Moznette of the Bureau of Entomology with headquarters at Miami, Fla., addressed the local Kiwanis Club on March 23, the Rotary Club on April 6, and the Chamber of Commerce on April 14, on the Miami mosquito problem and methods of ridding the city of the mosquito menace. These talks were a part of the program for arousing public support for the city's campaign against mosquitoes.

He urged the co-operation of clubs, churches and schools in eliminating the mosquito in that region.

The first New England Health Institute was held at Hotel Bond, Hartford, Conn., May 1–6. The health departments of all the New England States co-operated with the U. S. Public Health Service and the medical schools of Harvard and Yale Universities. Between 500 and 600 were registered to take the courses and the New England States were all represented. The faculty consisted of 77 lecturers, Dr. John T. Black, Health Commissioner of Connecticut was Director, and Dr. W. E. Britton lectured on Wednesday, May 3, on "The Role of Insects in the Transmission of Human Diseases."

At a meeting of the Board of Directors of the Gorgas Memorial Institute, at Washington on April 1, announcement was made that the Panama Government had provided a site for the proposed Gorgas Institute of Tropical and Preventive Medicine. The site is adjacent to the St. Thomas Hospital, which contains laboratories and buildings and represents a cost of approximately $500,000.00 Dr. Richard Strong, professor of tropical medicines at Harvard University, has been elected director of the Institute. The board also announced the selection of the directors of the Gorgas School of Sanitation to be established at Tuscaloosa, Ala. They are: Dr. S. W. Welch, of Alabama; Dr. Charles F. Dalton, of Vermont; Dr. A. J. Chesley, of Minnesota; Dr. E. G. Williams, of Virginia; Dr. Lloyd Noland, medical director of the Tennessee Coal and Iron Company, and J. A. LaPrince representing the United States Public Health Service. This board will meet at Tuscaloosa during the last week in May and arrange the courses. At that time they will also probably elect a faculty.

The work of the Bureau of Entomology against malarial mosquitoes is now in direct charge of Dr. W. V. King, who has been engaged in medical entomological work for the Bureau for many years. He graduated from the Montana Agricultural College, and soon was employed in investigating the Rocky Mountain spotted fever. Afterward he was associated with the late A. H. Jennings in investigating the possible insect transmission of pellagra, at Spartansburg, S. C., and in New York City, in connection with the extensive investigation of the whole subject of pellagra by the Thompson-McFadden commission. Since the conclusion of the pellagra work, Dr. King has been stationed in Louisiana, at New Orleans and at Mound, where he has studied the relations between the various species of mosquitoes and the different forms of Plasmodium, and various features of malaria in co-operation with the International Health Board.

The dried fruit beetle. *Carpophilus hemipterus* (Linn.) has become a pest of dried fruits in the warmer interior valleys of California. Although it breeds freely in stored dried fruits, it is nowhere as serious as is the Indian meal moth, *Plodia interpunctella* Hbn.

The fig is a favorite food of the beetle and the ripening fruit often becomes infested on the trees, particularly if there is any indication of souring, and in the dry yards and packing houses it may often become a serious problem.

But one of the difficult problems in connection with the insect in question is its relation to the smutting and souring of the ripening fruit in the orchards. The beetle breeds freely in smutty figs and is attracted by soured as well as the sound fruit. During the winter the adults may be found in great numbers in decaying melons infested with the same smut that attacks the figs and also very abundantly in decaying apples and other rotting organic matter.

E. O. Essig

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American Association of Economic Entomologists—Proceedings of the Thirty-fourth Annual Meeting.

(*Continued*)

Afternoon Session, Saturday, December 31, 1921, 1.30 p.m.

PRESIDENT GEORGE A. DEAN: The first paper on the program is entitled "The Argentine Ant in Mississippi," by R. W. Harned and M. R. Smith.

ARGENTINE ANT CONTROL CAMPAIGNS IN MISSISSIPPI

By R. W. HARNED and M. R. SMITH

Fourteen years ago at the Chicago Meeting of the American Association of Economic Entomologists, Wilmon Newell, then of Louisiana, began a paper on the Argentine ant with the following remarks:

"It is not often that the economic entomologist is privileged to behold the coming of a new and dangerous pest, to see its numbers rapidly increasing for several years before it attracts more than casual attention from the 'layman,' and yet be practically powerless to avert the threatened catastrophe.

An insect problem practically unheard of by the majority of the members of this Association, is now presenting itself in the State of Louisiana, and will shortly present itself to most if not all of the southern portion of this country. It is, withal, a problem which in the writer's humble opinion will rank in magnitude alongside the problems presented by the San Jose scale, gypsy moth and boll weevil, but in marked contrast to these it is not likely to admit of remedial measures being as easily applied.

In his brief experience as an entomologist, the writer has not encountered or heard of any species which exercises its destructive abilities in so many different directions. As a household pest I venture the opinion that this ant has no equal in the United States. It is both a direct and indirect enemy of horticulture; direct by actual destruction of buds, blooms and fruit, and indirect by its fostering care of various scale insects and plant lice. In the latter role it becomes also an enemy of importance to shade and ornamental trees and plants. By its association with *Pseudococcus calceolariae* (Mask.) it may wipe out, or at least make unprofitable, the production of cane sugar in the South. By its successful antagonism of beneficial forms it becomes doubly injurious."

Although these statements were made fourteen years ago and this pest has been under observation in Mississippi during the years since then, the writers do not feel that they can improve on Newell's description of the injurious nature of this insect. As a prophet, however, he was not quite so accurate in predicting that the Argentine ant would not be likely to admit of remedial measures being as easily applied as for the San Jose scale, gypsy moth and boll weevil. In our opinion the remedy[1] that has been developed for the control of the Argentine ant compares favorably with the remedial measures that have been discovered for any of the insects with which it was compared.

The first Argentine ants were probably brought into Mississippi from Louisiana over 20 years ago. Twelve years ago there were about a dozen towns in the state that were known to be infested. The number of infestations has gradually increased from year to year until at the present time there are over forty different towns that are known to be infested. There are probably more that have not been recorded, as complaints seldom reach us until the ants have been present for several years and have become firmly established. All the entomological workers in the state have during the past year been on the lookout for new infestations. The nursery inspectors always look for the Argentine ant when inspecting nurseries, but so far this pest has not been found in any nursery in the State. Of its own accord the ant spreads in all directions only a comparatively short distance—not more than a few hundred yards each year. It makes "commercial jumps." This accounts for its appearance in practically all of the larger towns in the state, and investigations indicate that the ant generally first becomes established in a town near the freight depot or in the wholesale district.

During the past two years the Plant Board in Mississippi has been putting on Argentine ant control campaigns in cooperation with the various towns. Usually we receive complaints in regard to this pest from a few individuals and organizations. The people in the infested areas want help. We notify them that upon request of the Mayor we will send a man or two to make the preliminary survey at no cost to the town. Of course, a prompt and cordial invitation is usually received from the Mayor. We do not want to appear to be forcing ourselves upon any community. If any disgruntled citizen does not like it because we are looking for ants on his trees and fences, we can simply explain that we are there at the request or invitation of the Mayor of the city. In making the preliminary survey we map the limits of the infestation,

[1]The remedy is discussed in Farmers' Bulletin No. 1101 entitled "The Argentine Ant as a Household Pest," by E. R. Barber.

MR. N. F. HOWARD: No sir.

MR. G. E. SANDERS: There is an interesting point there. Magnesium arsenate proved quite a bit safer than calcium. I would like to hear the chemical reason for that from Professor Moore.

MR. WILLIAM MOORE: The conditions in the South, south of the James River, in geological surveys show that the natural water contains an excess of strong bases over strong acids, producing an alkaline water, due to sodium carbonate. Most if not all alkaline materials which give an alkaline reaction with phenolphthalein will react with acid lead arsenate.

It is of interest that although entomologists have been using lime for twenty years with lead arsenate to reduce the amount of soluble arsenate, the reaction of the lime actually increases the amount of soluble arsenate when mixed with acid lead arsenate. Concerning magnesium arsenate I believe there has been some objection by the Insecticide Board because of its injury. Mr. Howard reports from the South that magnesium arsenate gave less injury than with calcium arsenate. In the case of magnesium arsenate, the compound itself is somewhat more soluble than calcium arsenate. If there were no further decompositions more injury would be obtained with magnesium arsenate than with calcium arsenate but when the climate is such as to favor the action of carbon dioxide on the calcium arsenate, you get a decomposition of the calcium arsenate and it then becomes more injurious than the magnesium arsenate.

PRESIDENT GEORGE A. DEAN: We will now listen to Mr. W. E. Britton.

TOBACCO PLANT INJURED BY THE SEED CORN MAGGOT

By W. E. BRITTON,
State Entomologist, New Haven, Conn.

On the plantation of the Windsor Tobacco Grower's Corporation at Windsor, Conn., a large acreage of tobacco is grown under cloth for cigar wrappers. In one field of forty acres, one half, or twenty acres, soon after setting, had the plants injured by maggots which tunneled into the sides of the stems just below the surface of the ground. In some cases the injury was very slight and inconspicuous and showed only as a small pin-hole in the side of the stem, but in other cases the tunnel was considerably enlarged inside the stem and extended upward or downward in the pith for half an inch or more. A slight decay had started around the injury in some plants. The manager examined and

counted 100 plants, and found that between 80 and 90 of them were infested.

I visited the field by his request on May 26, 1921, perhaps two weeks after setting. At that time nearly all of the maggots had left the plants and most of them had pupated in the soil close to the stems of the plants. It seemed to me that most of these plants would recover, but the manager stated that any injury to the pith is sufficiently serious so that the plant will never develop a good crop of wrapper leaf tobacco. This opinion seems to be shared by experienced tobacco growers generally.

Material was gathered and placed in breeding cages in the insectary and on May 31 and following, several adult flies emerged. Specimens were sent to the Bureau of Entomology at Washington, and the species was identified as *Hylemyia cilicrura* Rond., otherwise known as *Phorbia* (or *Pegomyia*) *fusciceps* Zett., commonly called the "seed corn maggot," and the "bean maggot." This insect is closely allied to the onion maggot, *Hylemyia antiqua* Schiner, the cabbage maggot, *Chortophila* (*Phorbia*) *brassicae* Bouché, and the spinach leafminer, *Pegomyia hyoscyami* Panz. Though this insect has an extensive literature and is known to attack a great number of vegetable and field crops, I have not been able to find tobacco mentioned as a food plant. Now the insect is guilty on another count.

The tobacco was grown on a light sandy soil, and the manager informed me that this particular section of twenty acres was covered with clover the preceding season and was plowed under last spring. The ground was harrowed and reset, and no further trouble developed. The injury was not found on any other ground except on this section where clover sod was plowed under.

MR. W. P. FLINT: It might be interesting to know that we had two cases in Illinois this year where newly set strawberry plants were injured in the same way by the corn seed maggot. In one rather large field, about two and one-half acres in all, there were spots over the whole field where plants were destroyed.

PRESIDENT GEORGE A. DEAN: The next paper is by Z. P. Metcalf.

THE TRAP BED METHOD FOR THE CONTROL OF THE TOBACCO FLEA BEETLE

By Z. P. METCALF, *Raleigh, N. C.*

(Withdrawn for publication elsewhere)

MR. E. G. KELLY: I would like to ask at what time the farmers spread the canvas over the beds.

Mr. Z. P. Metcalf: In North Carolina the custom is to put the canvas over the bed a short time after the seed is sown.

Mr. W. E. Britton: I would like to ask about dipping the plants at the time of seeding?

Mr. Z. P. Metcalf: We have secured excellent results from dipping the plants at the time of seeding. I think that is a necessary part of the program as far as North Carolina is concerned.

Adjournment.

INSECT PROBLEMS IN INDIANA DURING 1921

(*Condensed*)

By John J. Davis, *West LaFayette, Indiana*

The past season has been one of unusual insect activity in Indiana, as in other sections of the United States, due apparently to a combination of causes, important of which were the mild winter of 1920-21 and the unusual seasonal weather conditions the past summer. On the other hand, the scarcity and almost total absence of grasshoppers in destructive numbers throughout the state was very noticeable. The weather conditions favoring insects were the high temperatures which ranged from 2° to 10° F. above normal through the season, excepting for a short period the latter part of July, the excessive rainfall which averaged nearly two inches above normal, excepting a period during midsummer, and the long developmental season which began early in March and continued late. In other words Indiana moved two to three hundred miles south so far as weather conditions were concerned and insects had ideal conditions to increase and develop.

The first crop pest of importance to be noticed was the clover leaf weevil (*Phytonomus punctatus*), which occurred in destructive abundance throughout the southern half to two-thirds of the state. The first reports were received from the extreme southern end March 21 and frequent reports were received from that date until the end of April. In some sections large acreages of both red and mammoth clover were killed by this insect.

Hardly had the leaf-weevil outbreak subsided until we began to receive reports of serious damage to red and English clover by the so-called lesser clover-leaf weevil but which we prefer, because of its importance and feeding habits, to call the clover-bud worm (*Phytonomus nigrirostris*). Reports of injury were most numerous from May 17 to June 16 and were confined largely to central Indiana. The clover-bud worm is a pest of comparatively recent prominence in Indiana but

for the past five or six years it has been gradually increasing in abundance, particularly in central Indiana, until it has become a clover pest of prime importance. Apparently it is not an insect which occurs periodically but rather is one to be expected as an annual pest and its range of destruction is being gradually extended each year. The insect seems to prefer red and English clover and the injury caused by the larvae is to the developing buds, these being killed by the larvae which feed on the buds beneath the basal leaf sheaths.

The striped cucumber beetle (*Diabrotica vittata*) is an annual pest of considerable importance to cucumber and melon, which are extensively grown and valuable crops in Indiana. The calcium arsenate and gypsum (1 to 20) remedy suggested by Prof. H. A. Gossard was extensively used in some sections of the state, and in all cases which have come to our attention it proved thoroughly satisfactory. As an example, on May 10 the beetles made their conspicuous appearance at LaFayette, coming in swarms, apparently with an easterly wind, from the bottom lands of the Wabash river, nearly a mile away. They attacked the cucumbers in frames, by the thousands. Within a day after their appearance the plants were dusted with the calcium arsenate-gypsum mixture with very evident positive results, the beetles being found dead on the soil a day later and very few live ones left to molest the plants. The cucumber beetle is most serious in Indiana during the months of May and June and reports were received mostly during June.

Aphids were abundant in some sections of the state, the most prominent of which were the black peach aphis (*Anuraphis persicaeniger*), the melon aphis (*Aphis gossypii*) which appeared late but was very destructive nevertheless, and the gooseberry aphis (*Aphis houghtonensis*).

Flea beetles of various species, including the black flea beetle and the striped species, were unusually abundant in Indiana the past season, particularly in the western half and southern two-thirds of the state. Corn and potatoes were the usual crops attacked and the first reports were received about May 20, and numbers of reports continued to come to our attention until early in June.

The cabbage root maggot (*Phorbia brassicae*) which is particularly destructive to early cabbage, cauliflower and radish in the northern part of the state, is without question the most important pest of these crops in Indiana. Experiments were conducted at Fort Wayne and near Hammond, Indiana, and the practicableness and effectiveness of corrosive sublimate treatments, both as a dust and as a liquid, were thoroughly demonstrated. The results of these experiments are given in Leaflet 123 of the Purdue University Agricultural Extension Department.

Shade tree insects were prominent the past year, particularly the cottony maple scale (*Pulvinaria vitis*) and oyster shell scale (*Lepidosaphes ulmi*). Both insects were unusually prevalent in the northern half of the state. Reports of the cottony maple scale began to come in the latter part of May and continued throughout the month of June. Hardly a town in the northern half of the state but what reported trouble from this insect. Less evident, but in some cases just as serious was the oyster shell scale. By June 3 the over-wintering eggs had begun to hatch in all parts of northern Indiana and in general, they all hatched out in a comparatively short time. On June 15, some days after all of the eggs had hatched, and after they had formed a considerable scale, we sprayed a lilac hedge, at LaFayette, Indiana, with two mixtures: one, nicotine oleate at the rate of one ounce to a gallon, and the other fish-oil soap and nicotine extract at the rate of one pound soap to five gallons of water, to which was added one ounce of nicotine sulphate. Counts from different sections of the hedge gave us 84 per cent. mortality in case of those sprayed with the soap and nicotine sulphate, and 80 percent mortality in case of those sprayed with nicotine oleate. In general, our observations indicate that fish-oil soap is preferable to nicotine oleate for the control of immature scale insects such as oyster shell scale, cottony maple scale, and San Jose scale.

Rose beetles (*Macrodactylus subspinosus*) were more abundant in Indiana than usual, injury being reported from points in the extreme southern and in the extreme northern end of Indiana, the first reports being received May 26 and the last June 16. Inquiries referred to the rose beetle as damaging peach, grapes, corn, and rose, and in one instance, we had a report of the poisoning of poultry from eating rose beetles.

The latter part of June we began to receive reports of chinch bug abundance. Previous surveys and observations indicated that the chinch bug would be abundant in many sections of the state. Following these indications, chinch bugs were more abundant and more destructive than they had been for many years. Fortunately, however, rainy weather during the hatching of the eggs of the second brood prevented more widespread injury which otherwise would undoubtedly have resulted. Our experiments demonstrated the value of the creosote barrier band as recommended by Flint of Illinois, and they also showed that infestations could be controlled after the bugs entered the corn field, but before they scattered, by the use of fish-oil soap sprays and nicotine sulphate with soap. Although the late summer weather conditions did materially reduce the numbers of the bugs many went into hibernation successfully and there is every reason to believe that the infestation

next year will be equal or greater and more widespread than the present year unless weather or other natural conditions prevent.

Blister beetles (*Epicauta vittata*, *E. cinerea*, *E. marginata*, *E. pennsylvanica*, and *Macrobasis unicolor*) were more abundant than usual, attacking potatoes, tomatoes, and other garden crops. This appears to be a logical sequence following grasshopper outbreaks of recent years.

White grubs (*Lachnosterna* spp.) were also more abundant than usual and the reports of injury were received from many sections of the state. Reports were received during the months of July, August, and September, and the crops most commonly injured were corn and strawberries.

During the latter part of September we began to receive reports of various insects attacking alfalfa and in a few cases clover also. The first of these, the alfalfa web-worm, (*Loxostege similalis*) was found to be damaging alfalfa in many sections of the extreme northern and northwestern sections of the state, the latter third of September. Almost simultaneously reports and specimens of the fall army worm (*Laphygma frugiperda*) were received from the same section of the state. The crops injured in this case were alfalfa and clover. A third lepidopterous larva was repeatedly reported from the northern half of the state, the last of September and during October. This insect resembles the corn earworm in many respects but there seems to be certain consistent differences which may or may not be specific. Adults have not yet been reared.

The corn earworm (*Chloridea obsoleta*) was unusually abundant the latter part of September and during October. It was prevalent throughout the state, both field and sweet corn as well as many other plants being injured. There has been much fear manifested by farmers throughout the state as to possible harm to cattle feeding on earworm-infested corn. Observations to date indicate that corn earworm injury and the usual moulds following such injury are not harmful to farm animals but that certain other moulds which were prevalent the past season, but which do not follow corn earworm injury, may under certain conditions be harmful to animals.

Another insect which was unusually abundant the latter part of September and the first of October was the cotton caterpillar (*Alabama argillacea*). These moths appeared in isolated sections of the state and were reported as damaging various crops such as apple, but particularly were they destructive to ever-bearing strawberries in the northern part of the state.

Insects such as the peach tree borer, codling moth, fruit tree bark

beetle or shot-hole borer, Hessian fly and San Jose scale were reported to us throughout the season.

The peach tree borer (*Sanninoidea exitiosa*) has been the subject of repeated inquiries which resulted from publicity given the new PDB (ParaDichloroBenzene—Positive Death to Borers) treatment. Our experiments the past spring made in various sections of the state from the extreme southern to the extreme northern end show that spring applications (made during the month of May) are thoroughly effective against the peach tree borer and may be used to advantage where the fall applications have been neglected. We also found that the sublimed or flaky form and granular were equally effective as was also the crude granular. The latter was furnished us by the International Chemical Company of Cleveland, Ohio. If regularly available, it can be purchased at a much less price than the pure form and gives just as good results. It was also determined after a number of tests that treatment on sod ground was just as effective as where the ground was cultivated.

The Hessian fly (*Phytophaga destructor*) appeared in appreciable numbers last spring, the first eggs being observed at LaFayette April 4. Although there was an appreciable infestation, it did not show up conspicuously by fallen straws as is usual with these spring infestations. Instead the spring brood of larvae killed the shoots while they were small, the injury more nearly resembling the fall injury by the fly. Heavy parasitism undoubtedly reduced the numbers for the fall generation appreciably but throughout the state wherever wheat was sown earlier than a week before the recommended fly-free date, heavy infestation resulted. Fortunately, sowing wheat after the fly-free date in Indiana was almost universal, and with good results.

The San Jose scale (*Aspidiotus perniciosus*) is apparently increasing in abundance in Indiana, necessitating further studies, particularly with reference to the efficiency of the dry lime-sulphurs. The causes for the increase are apparently due first of all to improper applications and lack of thoroughness. Whether or not the spray gun has had its influence in this connection is a question which cannot be answered with certainty at the present time but there is a tendency to do less thorough work with the gun than with the rod. Other contributory causes are probably, improper dilutions, time of applications, variable insecticides on the market, and effect of parasites and predatory enemies.

Tests were made the past spring in two localities in southern Indiana to determine the relative efficiency of different dormant sprays now on the market. Applications were made to apple late in the spring when the buds showed pink, practically a delayed dormant spray. A stand-

ard miscible oil and liquid-concentrate lime-sulphur were used in comparison with several brands of dry lime-sulphurs, and at least four trees were treated with each material. The regular summer sprays were applied by the orchardists, all trees receiving the same treatment after the dormant spray. While it is not desirable to make definite recommendations or draw definite conclusions from the results of a single season's observations, the results show a general tendency which are interesting. Counts were made a month after the treatment to determine the percent of live scale; three months after the applications to determine the approximate infestation on the new twigs, and in the fall to obtain the leaf infestation. The first count was a careful examination of 250 scales to get the percent of scales alive. The second count was an estimate of the infestation of the new twigs. The third count was an actual count of the scales on 100 leaves collected from different trees. Miscible oil, 1 to 15, and liquid-concentrate lime-sulphur, 1 to 7½, gave very good control. None of the dry lime-sulphurs, soluble sulphurs, or barium tetrasulphide, gave results comparable with the liquid concentrate, when used at label strength. Some gave fair results at (1½) label strength and most gave good results, equal to the liquid concentrate, when used at twice label strength. It might be added that the dry lime-sulphurs did give appreciable controls over the untreated.

From these results we do not feel justified in recommending dry lime-sulphur, but if the liquid or miscible oil are not available, dry lime-sulphur should be used at 1½ to 2 times label strength.

The experiments are being continued, and in addition, tests are being made to determine the value of fall versus spring applications, and the relation of spraying to parasitism, etc.

THE MAPLE CASE-BEARER *PARACLEMENSIA ACERIFOLIELLA* FITCH.

By Glenn W. Herrick

Although the census of 1920 indicates that, on the whole, the volume of the maple sugar industry of New York State has decreased during the last twenty years yet the total value of the maple sugar and syrup manufactured during 1919 was $3,399,434 a substantial increase over any previous year of which data are available. There are probably several factors that have contributed to this decrease in volume of the maple sugar industry one of which is undoubtedly the deterioration of the trees through the inroads of disease and insect pests.

During the last three years a small tineid moth has become so abundant and its caterpillars have proved so destructive to sugar maples that the owners of many groves have become alarmed over the prospects of the destruction of their trees. Just what factors have contributed to the sudden and wide increase of this tiny pest during this period it is impossible to say. Nor can we predict with any degree of certainty when the natural factors which appear to hold it in check during most years will again come into the ascendency.

History of the Insect in New York State

The maple case-bearer was first noticed in New York State during the summer of 1850 by Asa Fitch who gave a brief and interesting but not complete account of its habits and ravages (1856). No reference can be found regarding it in New York from that time up to the year 1911 a period of about 60 years, when E. P. Felt (1912) mentions it as abundant and destructive near Bolton, on Lake George. Apparently the insect has continued more or less destructive over a considerable portion of the State since 1911 although it may have already reached its climax.

The Name of the Insect

When Fitch described the insect in his report for 1855 he called it the maple leaf-cutter and this common name has been used by most writers since. However, since the insect is rather closely related to other common case-bearers and since each caterpillar after its first period as a miner is never without its curious case and always lives within it, the name *maple case-bearer* is now proposed as the common name of the insect.

Like many other insects, the maple case-bearer has been named and described several times. Its history in this respect is shown by the following synonymy:

1856. *Ornix acerifoliella* Fitch. Second Rept. Nox. Ben. and other insects of New York, p. 269.
1861. *Incurvaria acerifoliella* Clemens. Proc. Ac. Nat. Sci's. Phil. for 1860, p. 5.
1873. *Tinea iridella* Chambers. Can. Ent., Vol. 5, p. 86.
1903. *Brackenridgia acerifoliella* Busck. Proc. Ent. Soc. Wash. Vol. 5, p. 193.
1904. *Paraclemensia acerifoliella* Busck. Jour. N. Y. Ent. Soc., Vol. 12, p. 177.

Distribution, Foodplants, and Injuries

Evidently this insect is widely distributed over the northeastern United States and southern Canada. It has been recorded from Vermont, New York, and New Jersey westward to Illinois in the United States and in Canada from the Provinces of Quebec and British Columbia.

The author has observed and collected it in the vicinity of Long Point, North Ferrisburg, and Burlington, Vermont, near Deposit,

N. Y., where it is abundant and injurious in a large sugar-bush and near South Colton, West Pierrpont, De Grasse, and Russell in St. Lawrence Co. in all of which localities it is seriously injurious. Felt has recorded it as abundant and injurious near Bolton, N. Y. It is probably widely distributed throughout the Adirondack region.

The author has never found the larvae on anything but the sugar maple although I have reared them to maturity on the red maple (*A rubrum*). Fletcher (1884) records the larvae feeding on the foliage of beech trees growing among infested maple trees after the foliage of the latter had been devoured.

The first indication of the presence of the insect in a grove is during the first half of June when the leaves begin to lighten in color owing to the multitudes of tiny blotch mines in which the young larvae have already eaten out the green tissues. The effect on the leaf at this time is certainly more serious than has been suspected. As many as 116 mines were counted in a single leaf in which a large part of the green tissues had been destroyed. After the mining period, which probably occupies about 10 days, the larva cuts out a small oval case and thereafter lives on the surface of the leaf, eating the epidermis and green tissues in a circle about the case as far outward as it can reach. Since the larva cannot reach the surface of the leaf directly beneath its case this oval area remains green and when the larva bears its case to a new location a disk-shaped green oasis, as it were, is left surrounded by an oval band of whitened and bleached tissue. Moreover, as the larva molts it cuts out each time a larger and larger oval piece of the leaf to add to its case. Thus it happens that in the latter part of July and first part of August the foliage of infested trees becomes brown with oval ring-like bands of bleached tissue and riddled with holes of varying sizes. A badly infested woodland will present in August and September a characteristic brownish appearance as though scorched by fire.

Felt (1912) records an area of woodland near Lake George of probably twenty-five acres as severely injured. Near Deposit, N. Y., a sugar-bush of ten or twelve acres has been severely injured for four or five years and during 1920 and 1921 it presented a striking and severely injured aspect during the late summer. Many of the younger trees in the central portions of this grove have been killed and the older trees have been so injured that the grove has fallen off markedly in its yield of sap during the last three seasons. In St. Lawrence County the maple groves are suffering severely from the work of this insect. Over much of the higher parts of the county the trees are

heavily infested and show marked injury. Owners complain of the falling off of their groves in production during the last two or three years.

LIFE HISTORY

Practically nothing is known of the life history and habits of this case-bearer except the notes made by Fitch on the larvae after they had formed their cases. The insect passes the winter as a pupa in its case on the ground among the fallen leaves. Here at Ithaca, in our breeding cages, the moths issued through the middle and latter half of May, beginning May 11 and continuing up to May 23. At Deposit, N.Y., I found the moths in great abundance on May 30, 1922, and many eggs had already been deposited by them. W. T. M. Forbes took the moths on May 17, 1922, at Trenton, N. Y.

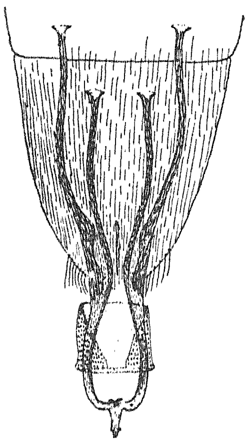

Fig. 10. Ovipositor of *Paraclemensia acerifoliella*, dorsal view.

The moth has a complicated extrusory ovipositor (Fig. 10) with which she deposits her eggs in tiny pear-shaped pockets in the tissues of the leaves just beneath the lower epidermis. The moth rests on the underside of the leaf with her abdomen bent forward beneath the body and with the tip pointing forward. With her body as a fulcrum she bores a tiny circular hole through the epidermis and forms a pear-shaped pocket in the tissues. In the larger end of this she places her egg (Fig. 11). The egg is soft, white, and elliptical, and measures about .45 mm. in length, .34 mm. in width and .24 mm. in thickness. It probably hatches in about one week, for on June 16, 1921, the larvae were in great numbers in the leaves and nearly ready to desert their mines, which many of them began to do the next day, the 17th. When the egg hatches the young larva begins at once to mine in the tissues of the leaf and continues to live as a miner for probably about 10 days. In general the mines are irregularly linear although each one tends to enlarge somewhat towards the terminus

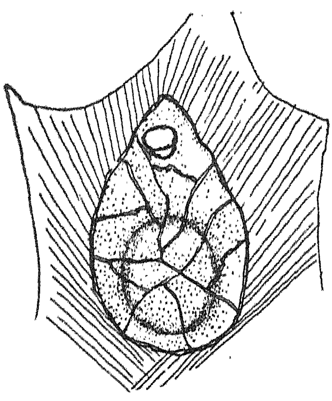

Fig. 11 Egg of *Paraclemensia acerifoliella* in a pocket on the underside of a leaf.

and to become a blotch. The mines are most conspicuous from the upper surface of the leaves and may be very numerous in a leaf. Counts were made of the mines in six different leaves and the number varied from 24 in the least to 116 in the worst infested leaf.

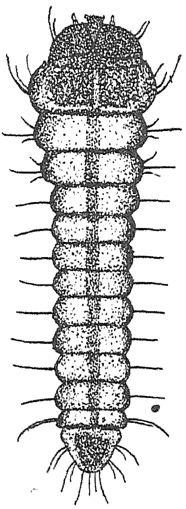

Fig. 12. Larva of *Paraclemensia acerifoliella*, a miner in a leaf.

The young larva is greenish-brown in color with a dark brown head. The body is somewhat flattened, the prothorax is broadened and the thoracic legs are present at least during the latter part of its life as a miner. The abdominal segments are prominently enlarged on each side, giving the appearance of a Coleopterous larva. When ready to leave its mine the larva is about 1¼ mm. in length (Fig. 12). The full-grown larva is about ⅕ of an inch in length.

When the larva has completed its growth in the mine it cuts its oval case out of the mine. The larva then walks out on the leaf and deftly turns the case over so that the thicker piece from the lower epidermis is on top. The larva develops slowly, occupying nearly the whole summer to complete its growth. I am not yet sure of the number of instars and molts but head measurements indicate five molts. The final case of the larva in the fall consists of four oval pieces, two small inner ones and two large outer ones.

The process of cutting out a piece of the leaf for the case is an interesting one. The larva when feeding attaches its case to the leaf by short silken cords at intervals about the edges. These cords are composed of many threads spun in such a manner that they cross each other near the middle and form an X-shaped cord. When ready to cut out a new piece for its case the larva cuts a half-oval slit in the leaf which extends about half around the old case (Fig. 13). It then cuts a half oval about the opposite end of the case and later joins the ends of the slits, thus completing the circle. The new piece, however, is held in place by tiny strands of leaf tissue which the caterpillar leaves for supports. Later, when the larva is

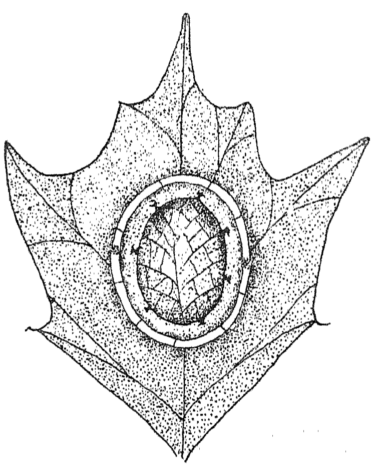

Fig. 13 The case of *Paraclemensia acerifoliella*, note the circle nearly cut around the case.

ready, it cuts these strands and walks out on the leaf where it dexterously turns the case over.

The Pupa

The pupae are light yellowish-brown in color tapering strongly to a point at the posterior end (Fig. 14). The larger ones (females?) are 4 mm. in length. The smaller ones (males?) average about $3\frac{1}{3}$ mm. in length. The appendages of the thorax and head are free and not glued to the body. On the dorsal side of the body there is a transverse row of short, stiff, brown, backward pointing spines on the 2, 3, 4, 5, 6, 7, and 8 abdominal segments. There are also two conspicuous filaments projecting forward from the head.

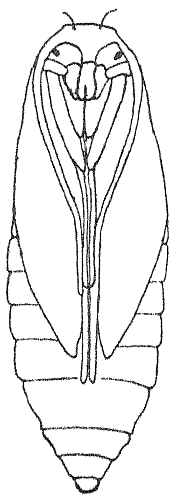

Fig. 14. Pupa of *Paraclemensia acerifoliella*, ventral view

The pupal case consists of four oval pieces, two larger outside pieces and two smaller inside ones. The two inner pieces are quite thickly lined with silk on the inside and between these layers the pupa is ensconced. The edges of the inner pieces of leaves are tightly fastened together with silk but an opening is apparently left at the anterior end of the cocoon as an exit for the pupa when it transforms to a moth. The large outer top piece of the case is loosely fastened and often falls off in handling. The larvae, in 1920 evidently transformed sometime during the month of October for on Nov. 2 when a box of leaves from Deposit were examined only pupae could be found.

The Moth

The moth has a wing expanse of about one-half an inch, some individuals exceeding this slightly and some not quite reaching it. The front wings and thorax are of an iridescent steel-blue color with a purple reflection while the hind wings are pale-brown and bordered with a fringe of long hairs. The fore wings are pointed and each bears a fringe of hairs on the outer third on both the front and hind margins. The head bears a tuft of bright orange-yellow hairs and the abdomen is dark-brown while the legs are whitish.

Seasonal History

The moths emerge from the pupae among the fallen leaves during May and deposit their minute eggs in the leaves. These hatch in a few days and the young larvae begin mining in the tissues between

the lower and upper epidermis of the leaves. Probably in about ten days to two weeks the larvae complete their work as miners and begin constructing oval cases which they cut out of their mines in the leaves.

The larvae live as case-bearers during July, August, and September falling with the leaves and changing to pupae within their cases. Here among the fallen foliage the pupae remain until the following spring. There is thus but one generation each year.

Methods of Control

Trees standing in a pasture where the leaves are blown away even though they were only a few rods from a badly infested woodland were scarcely touched by the insect. This suggests that if the leaves were raked in piles and burned or otherwise destroyed the pest could be held in check. This, of course, would entail considerable time and labor but if well done for once only the pest would be effectively checked for several years.

The only other feasible control consists of a thorough dusting of a grove with arsenate of lead by means of an airplane which now seems to be within reasonable possibility.

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ARTIFICIAL PRODUCTION OF HOPPERBURN

By F. A. Fenton and I. L. Ressler

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While there have been numerous tests made which have shown that *Empoasca mali* LeB is capable of producing hopperburn when placed on potato leaves, yet there has been comparatively little done in the way of inoculation tests with this insect. The writers conducted experiments during the past summer in order to observe the effects of the injection of leafhopper extract and of dilute poisons into the leaf tissue as well as to test out further the results of multilation of potato leaves, and were able to secure interesting data which may help toward the ultimate solution of this problem. Potato leaves were mutilated with various instruments, inoculated with dilute acid and alkali, and with water in which *mali* adults, nymphs or hopperburned tissue had been macerated. Also further tests were made in which these insects

were crushed on the leaf tissue or leaf petioles and in which the macerated leafhopper juice was drawn into the leaves by leaf transpiration.

WHAT IS HOPPERBURN

There are several types of injury found on potato leaves which are characterized by the death and turring brown of the leaf tissue. These have often been confused and described under the general term tipburn. The writers believe that much of the skepticism concerning the recent work on hopperburn is because of a failure to distinguish between these various leaf disorders. It therefore seems advisable at this point to describe briefly the injury which should be characterized as hopperburn and to compare it with other related leaf burns. Hopperburn always begins at the margin of the leaf and the burning is correlated with the veins. This relationship is not evident in older hopperburned leaves but is easily seen in the earlier stages (Fig. 15, 1-4) when the triangular or diamond shaped areas are seen to run in from the margin and to follow the veins. Other

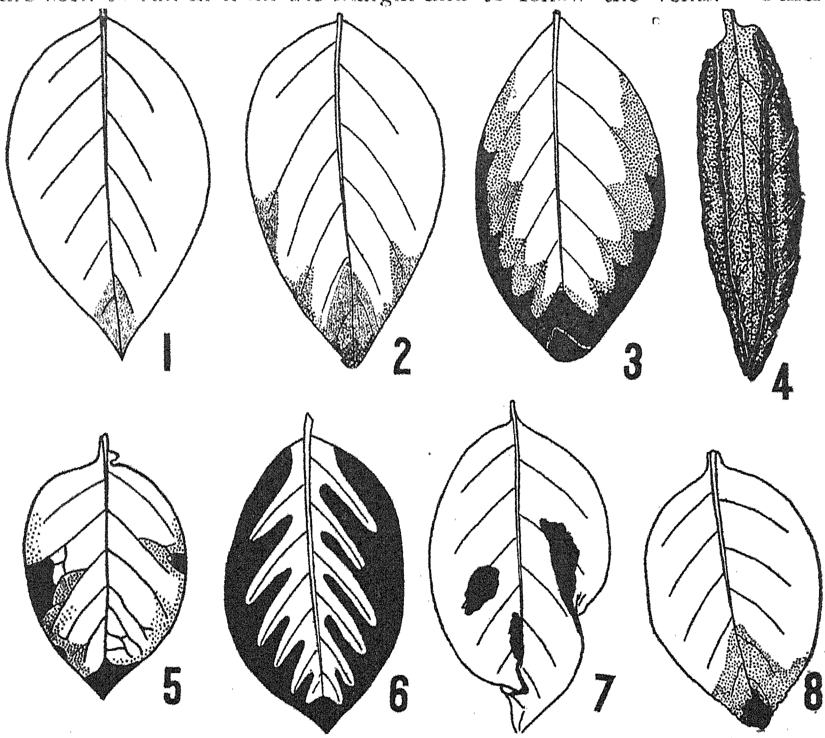

Fig. 15—Comparison of hopperburn with other leaf burns. 1–4. Successive stages of hopperburn; 5. tipburn (after Lutman); 6. scorching; 7. sunscald; 8. greenhouse burning.

characteristics are the deep brown color of the burned areas, the curling upward and rolling in of the leaf margin and the crisp, fragile nature of the dead tissue. Tipburn as characterized by Lutman (Fig. 15, 5) has no relation to the venation, a fact which distinguishes it at once from hopperburn. The writers are not familiar with this type of burning which apparently is not common in Iowa. Burn injury (Fig. 15, 6) is rarely seen in the field but can be produced experimentally by placing leaves near intense heat. The burned areas in this case always run between the larger veins, the tissue immediately surrounding these being the last to die. Sun-scald (Fig. 15, 7) is fairly common in Iowa but is not serious. It is noticed usually before the first signs of hopperburn appear and is the result of the action of the sun's rays through drops of water resting on leaves after a rain. These drops of water, if they are not evaporated or blown from the leaf soon, act as minute burning glasses and the tissue beneath burns brown. This injury is not correlated with veins or margins. The leaf is also distorted in the affected region by being folded. Another type of injury (Fig. 15, 8) is commonly seen on potato leaves in greenhouses. It resembles hopperburn in that it is correlated with the veins and begins at the margin and it also often appears on the lower and older leaves of the plant. It is distinct from hopperburn, however, in that the tissue only turns a comparatively light brown, there is little or no curling upward and rolling in of the leaf, and the burned area is more or less leathery in texture. Leaves affected with this disease appear limp and wilted. This is discussed in more detail in the following paragraphs.

Effect of Mutilation of the Potato Leaves

Preliminary experiments on the effect of mutilation of potato leaves have already been mentioned.[1] This year these tests were repeated, using sterilized as well as non-sterilized instruments. The first series of tests consisted in pricking the larger veins with *minuten Nadeln*, once or several times both before and after these were sterilized. Seven days later the first signs of burning were noticed on several of the leaves so treated. This appeared in the form of a very small triangular brown area at the tip of the leaf and developed regardless of whether a sterilized or non-sterilized needle had been used. On the fifteenth day after the veins had been pierced all of the leaves but one showed this same type of injury.

Other leaves were similarly treated, using instead of the needles the fine, sharp ovipositors of two species of parasitic Hymenoptera.

[1]Fenton, F. A. Journal of Economic Entomology, Vol. 14, No. 1, pages 71-72, 1921.

Of the two types of ovipositors used, one, the larger of the two, was comparatively short and stout, while the other was longer, finer and more flexible. These were used both before and after being sterilized. After 15 days a small burned area appeared at the tips of some of the leaves but several remained normal.

Finally, several leaves were mutilated by severing one or more of the larger veins and the midrib with a scalpel both before and after sterilizing the instrument. Seven days after this test a small dead area was noticed on one of the leaves mutilated in this manner, but this did not increase noticeably after this date.

Discussion of Mutilaton Experiments

In the above experiments it was noticed that the first signs of burning appeared suddenly on different plants on the same day. Possibly some abnormal change in temperature or humidity occurred on this date which was the real cause of the sudden appearance of burning. The fact that some check leaves showed this type of injury seems to substantiate this conclusion. Furthermore, the burned areas on the mutilated leaves were very small, and not at all similar to hopperburn. They did not enlarge in size nor were they preceded by any yellowing of the tissue, loss of turgidity, or curling upwards of the leaf as always accompanies typical hopperburn. The writers have repeatedly observed similar small brown areas on leaves that were not mutilated in any way and believe that under the abnormal conditions which are present in the greenhouse, the older leaves on a plant are very apt to show these areas. They feel therefore that they have not succeeded in producing anything which is at all comparable to hopperburn by mutilation of the leaves and that it is certainly not produced by the mere mechanical injury following feeding or oviposition by the leafhopper.

Effect of Dilute Poisons on Potato Leaves

Potato leaves were injected with five per cent hydrochloric acid and others with five per cent ammonium hydroxide by means of a hypodermic needle. Within 24 hours these leaves were wilted and shrivelled but there was no sign of burning. After this the leaves dried and the dead areas gradually turned a light brown color but the injury was in no way similar to hopperburn. Check leaves inoculated with water blanks remained normal.

Inoculation of Hopperburn Tissue Solution into Potato Leaves

On July 18 a small amount of solution prepared from a macerated potato leaf showing a trace of hopperburn was injected

into normal potato leaves. Other leaves were injected likewise with a solution prepared from a leaf showing advanced stages of this disease. Finally, leaves were inoculated with a solution prepared from a leaf that had been killed by hopperburn. By July 25 some of the leaves showed a slight browning at the tip and on July 30 all showed this same type of injury. On August 10 this experiment was closed as the injured area on the inoculated leaves had not increased and they were clearly not affected with hopperburn. The injury in this case was identical with that resulting from multilation and was probably a result of greenhouse conditions.

Inoculation of Potato Leaves with *E. mali* Extract by Means of a Hypodermic Needle

On July 19 approximately 100 *Empoasca mali* adults of both sexes were collected and macerated in 10 cc. of water that had been previously distilled and sterilized. Three potato leaflets were inoculated with the liquid drawn off from this solution and also the petiole of a single leaf was inoculated in the same manner. On July 25 there was a scar or lesion noticed in the mid-vein of each leaf where the needle had been pricked in. At the same time two of the leaves showed decided burning similar in every way to hopperburn, while the third showed the burning less distinctly. The injury increased daily and on July 30 there was no question but that a disease very similar to hopperburn had been produced in every case. On July 29 the above experiment was repeated, using in these inoculations a solution made from 58 adults of both sexes. Part of the leaves in this test were reinoculated 24 hours later by a freshly prepared solution made from 56 adults of both sexes. In this latter test a slight burning was produced but it was in no way comparable to the injury obtained by the first set of inoculations. Although fewer insects were used this was more than compensated for by the additional inoculation the following day.

On July 19 approximately 88 nymphs mostly in the fourth and fifth instars were macerated in 10 cc. of water that had been previously distilled and sterilized. Four inoculations were made of which three were in leaf tissue and one in a leaf petiole. Only one of the leaves so treated showed any signs of hopperburn injury, and on this one there was a small brown area at the tip. In all cases, however, there was a marked lesion produced at the point of inoculation. Here the tissue seemed to collapse and the mid-vein became distorted. In dried specimens these lesions are very distinct, showing that the nymphs

must have contained a toxic principle. Inoculation of check leaves with water blanks failed to produce injury.

Inoculation of Potato Leaves by Needle Punctures

On July 27, 80 nymphs in advanced stages were macerated in a small quantity of water. Small drops of this solution were placed on the under surface of the leaves and then using a very fine needle, the leaves were punctured 25 times. This procedure was repeated July 28, 29 and 30. July 31 one leaf so treated showed a slight burning at the tip but the others were normal. August 2 all leaves so treated but one showed a slight curling. August 10 this experiment was closed, there being no sign of hopperburn on any of the leaves, although there was a large scar at the point of inoculation.

Inoculation by Means of Crushing the Nymph on a Leaf Abrasion

Having failed to get positive results in the above tests, it was decided to crush the live insects on the leaf, making in so doing a cut in the leaf surface. Three fifth instar nymphs were crushed near a large side vein of one leaf; one each day, on July 27, 28 and 29, respectively. At each point of inoculation the tissue turned yellow and then brown, but the injury was very localized and the rest of the leaf remained perfectly normal. A second leaf received the same treatment except that on the first day a fourth instar nymph was used and the results were the same. Thirteen nymphs in various stages were crushed on a third leaf during a three day period and in this experiment the injury was much more noticeable. Not only did the tissue immediately beneath the crushed nymph turn brown but also the area surrounding it was affected in the same way. This was proof that the nymphs contain a toxic substance but in small quantities.

Inoculation of Potato Leaves by Leafhopper Residue

On July 29 the residue left over from 58 crushed adults in the needle inoculation experiments mentioned above was placed on potato leaves and leaf petioles and pricked in with a fine scalpel. Twenty-four hours later the tissue beneath had whitened and there was a decided lesion. However, the injury continued to remain localized and the leaves were apparently little affected by this except in one case. Here the lesion on the petiole was so pronounced that it was nearly girdled. This experiment demonstrated that the adults apparently possess the same toxic substance as the nymphs and further it partially explained the lack of better results in other inoculation tests; namely, that the mere

crushing of the insects apparently fails to dissolve enough of this toxic substance to produce injury in all cases.

Experiments with Potometer

It was thought that it might be possible to get more of the leafhooper solution into the leaves by cutting them off and placing the stems in the solution so that it would be drawn up into the leaf by transpiration. Accordingly, a number of hollow glass tubes were bent into a "U" shape, a rubber tube was placed securely over one end of the glass tube and then into this rubber tube the stem of an entire leaf was firmly placed and held there by grafting wax. After trying this out and finding that most of the leaves remained fresh for some time under these conditions with water in the tube, a solution made from 50 crushed nymphs was poured into one of the tubes. The diameter of the tube was so small that it was possible to fill it with a highly concentrated extract. As this was darker colored than the water it could be easily seen that the extract was being drawn up into the leaf which promptly became flaccid and remained so without entirely wilting for five days. At the end of five days, on August 29, the leaf was removed. It had yellowed in certain areas, and there had been a tendency for the margin to roll up, a condition similar to the beginning of hopperburn. It was found that the cut end of the stem had partially decayed, a condition brought about by the fermentation of the insect remains in the water. The decayed part was cut off and the leaf placed with the stem in water. It soon freshened up and August 31 the leaf had recovered except in the injured portion. The injury resembled hopperburn very closely. Leaves in plain water remained perfectly fresh and showed no injury throughout this test, provided the apparatus was working properly. This experiment was repeated later with the difference that only the clear solution free from the insect remains was used, thus avoiding decay of the leaf due to fermentation. The leaf became flaccid as in the other case and then developed symptoms of hopperburn.

Discussion of Inoculation Results

The writers were at a loss at first to understand the variable results in the different inoculation tests with hypodermic needles as described in the preceding paragraphs. It was noted, for example, that extracts from crushed adults caused marked symptoms of hopperburn in one series of inoculations and negative results in another. Furthermore, it was noted that extract from crushed nymphs produced less abnormalities in the leaf tissue than from the macerated adults. This would indicate that

the nymphs contained less of the toxic substance than the adults, a fact not born out by previous experiments[1], where it was shown that the nymph is the more toxic of the two. Undoubtedly some difference in procedure not noted at the time may have been the cause of this. Failure to produce burning in all cases may have been due to inability to force enough of the liquid into the plant by means of the hypodermic needle. This represented a real difficulty in our earlier inoculation tests as the natural turgidity of the leaf made it almost impossible to force much of the extract in. The difference in the amount of extract injected into the leaves as a result of this turgidity may explain the difference in the effects of the toxin in the leaf. That the negative results of the earlier experiments may have been due to the failure to introduce enough of the hopper extract to produce burning because of the natural turgidity of the leaves is also indicated by the success of the tests with a potometer. Another factor entering in was the difficulty of getting very much of the toxic substance into solution by a mere maceration of the insects in distilled water. Apparently not all or perhaps not even much of the toxic substance was extracted by this method as was indicated by the highly toxic action on potato leaves, of the residue composed of macerated insects after the clear solution had been drawn off. That the live nymphs do contain this toxic substance was demonstrated a number of times by crushing them over a leaf abrasion. Very distinct lesions as already described resulted in every case.

The above tests need to be repeated on a larger scale and some better method devised for getting the toxin into the solution. Furthermore, extracts prepared from other insect species should be injected into the leaves as it is well known that insect sera often contain toxic principles.

EFFECT OF BORDEAUX MIXTURE ON *EMPOASCA MALI*

By F. A. Fenton and Albert Hartzell, *Iowa State College, Ames, Iowa*

Since the establishment of the fact that *Empoasca mali* LeB. is the cause of potato tipburn, it was found that Bordeaux mixture in some way prevented this foliage disease by its action on this insect. It was thought at first that it acted as a repellent[2] because plants sprayed with this fungicide were noticed to have comparatively few leafhoppers on them. The senior author[3] demonstrated later that this com-

[1]Fenton, F. A. loc. cit. pages 76-77.
[2]Fluke, C. L. Journal of Economic Entomology, Vol. 12, 1919, pages 256-257.
[3]Fenton, F. A. Journal of Economic Entomology, Vol. 14, 1921, pages 71-79.

pound acted as a repellent to the adults, the latter preferring to oviposit in unsprayed leaves when given a choice. Still further tests this year have also shown that while oviposition will take place when females are confined with plants completely covered with Bordeaux, yet very few eggs are laid under such circumstances.

TABLE I.—COMPARISON OF OVIPOSITION OF *E. mali* ON PLANTS COMPLETELY SPRAYED WITH BORDEAUX MIXTURE AND ON THOSE PARTLY SPRAYED

	Entire plant sprayed	Plant partially sprayed		Unsprayed check plant	Totals
		sprayed leaves	Unsprayed leaves		
No. females used	36	24	24	12	72
Total No. eggs laid	42	27	147	155	371
Average eggs per female	1.5+	1+	13—	6+	

The above table summarizes results obtained in 22 experiments in which a total of 72 fertile females were used and 371 hatchings obtained. In these tests the insects were all examined under a lens to see whether they were gravid or not and only the former were included in the tests. The same number was placed in each cage on plants that were known to be free from *mali* eggs from other sources. All insects were removed after a ten days' period and the hatching young were counted daily. Where there was a choice between sprayed and unsprayed leaves by far the majority of eggs were laid in the latter, the ratio being approximately six eggs per female for the ten day period in unsprayed leaves as against one egg per female in the sprayed. Where no choice was given the average was slightly higher on the sprayed leaves but here there were always some eggs laid in the unfolding leaves at the tip of the plant which were unavoidably partly or entirely free from the spray.

It was then decided to test out the action of Bordeaux mixture on these insects in more detail. Potato plants were sprayed thoroughly with this compound. Both the 4-4-50 self-prepared formula and several commercial dry Bordeaux powders that were mixed with water were used. Single leaves from plants thus treated were placed in shell vials with individual leafhoppers. It was soon observed that there was a surprising mortality among the nymphs and as a result more vials were started, the exact instar of the nymph in each case being noted. The following table is shown to illustrate one experiment out of several that were conducted. In all about 100 insects were used in these tests and the writers feel that the results although preliminary are yet of sufficient interest to be presented here.

TABLE II.—EFFECT OF BORDEAUX MIXTURE ON *Empoasca mali* NYMPHS

Instar	No. days lived			No. insects used
	Min.	Max.	Average	
1	1	4	2.3	10
2	3	4	3.4	5
3	2	7	3.9	7
4	2	7	4.4	7
5	3	9	6	7

In not a single case did any of the nymphs feeding on sprayed leaves become adults. In some instances the insect would moult once but very often death occurred directly after the casting of the exuvium or even before the nymph could completely extricate itself. Bordeaux mixture acted comparatively slowly, some of the older nymphs living as long as nine days. In general the younger the insect the quicker death resulted upon being confined on a sprayed leaf, the length of time ranging from approximately two days in the case of the first instar to about six for the fifth.

Careful observation disclosed the fact that the nymphs were not dying from starvation because they were either unable or refused to feed from the sprayed leaves. Once placed on a leaf well coated with Bordeaux, the hopper at first wandered about but sooner or later settled down and began to feed. In fact, very often the dead nymph would be found with its proboscis firmly fixed in the leaf tissue. Often twenty-four hours or more before death the insects would become affected, appearing sluggish and partly paralyzed. The fact that they were confined to shell vials apparently had little to do with it because in almost every case the nymph could be raised to maturity under these conditions on unsprayed leaves. Nymphs placed on sprayed potted plants in the insectary soon disappeared but whether they died or not is a question.

Similar tests with adults were carried out but as yet our data is insufficient on this subject. In the few vials observed some adults lived for over two weeks and this would appear to show that Bordeaux mixture is at least not very toxic to the adults and possibly it may not affect them at all in this respect.

FIELD EXPERIMENTS

The insecticidal value of Bordeaux mixture in the control of the potato leafhopper was also shown by results obtained from field plots at Ames. These plots consisted of a number of rows of potatoes of two varieties, namely: Green Mountain and White Blossom Irish Cobbler. These rows were sprayed with self-prepared Bordeaux mixture 4-4-50 formula alone and also in combination with black leaf

40 added at the rate of 1¼ pints to every 100 gallons of spray.[1] Applications were made June 17, June 28, July 7 and July 19, the spray being applied with a ten-gallon capacity hand pump.

Three plants were selected, one from each variety and one as a check, and the hatching leafhoppers were counted and killed daily. A total of 822 nymphs hatched from the Green Mountain, 864 from the Irish Cobbler, and 2573 from the check, the ratio of the counts on the unsprayed as compared with the sprayed being about three to one. This did not represent the actual control as the young first instar nymphs were removed directly after hatching and before the Bordeaux mixture could act on them. That this must have been the case was illustrated by the fact that on other sprayed plants only a few of the nymphs in the fourth or fifth stages were found. This indicated that comparatively few of the young survived after hatching from these plants and only because they were able to feed on unsprayed leaves, many of which could be found on the vines no matter how carefully they were sprayed. These daily counts also showed that this material was cumulative in its effects, there being a decrease in the leafhopper population which continued from day to day due, as cage tests showed, to the repellent action on the ovipositing females and the toxicity to the nymphs.

EXPERIMENTS ON THE BIOLOGY AND TIPBURN DISEASE OF THE BEAN LEAF-HOPPER WITH METHODS OF CONTROL. (*EMPOASCA MALI* LE BARON)

By A. H. Beyer

The Bean Leaf-Hopper is generally distributed over the State of Florida, and is one of the most important insect enemies of the bean and other crops growing in the trucking sections of the state. The northern portion of the state, including Gainesville where the writer conducted his biological studies and experiments on control, during 1921, there was found to be an over-wintering period, while southern Florida including the latitude at least as far north as Plant City, where it was quite apparent that there is no over-wintering period. According to a survey which was made in early February the following facts were revealed: all stages of the life cycle were collected from the castor bean host, and an outbreak was recorded on garden beans (*Phaseolus vulgaris*) at Miami, Florida as early as March 24. The earliest outbreak in the

[1]The addition of nicotine sulfate did not increase the toxicity of the Bordeaux sufficiently to make any difference in counts between the two plots.

northern part of the state, occuring on cowpeas, was August 20th. Thus it is evident that the conditions regarding seasonal history differ widely in Florida.

SEASONAL HISTORY

The Bean Leaf-Hopper was first found feeding in the field on March 8, where it was collected abundantly on the poke weed (*Rivina humilis*) which was growing in fence corners. The Adult stage was observed feeding on the lower foliage and the largest percentage of those recorded were females, however a considerable number of over-wintering males still remained. In fact some mating was observed from these individuals. The females were placed in small, glass cylinder cages one inch in diameter, well ventilated and containing small plants for food, where they could be kept under close observation with hand lens and binocular. Egg scars were first found on the leaves March 10, and on March 18 the first nymphs were recorded.

Following is a series of generations as recorded in the outdoor laboratory at Gainesville during 1921:
Experiments:

March 11	May 2	52
May 2	June 20	49
June 20	August 5	46
August 5	Sept. 30	56
Sept. 30	Nov. 28	60
Nov. 28	Dec. 15	Feb. 27th, 1922

Making a total of six generations for the season.

The maximum number of nymphs produced per female	131
The minimum " " " " " "	22
The average " " " " " "	59.3

The length of life of the adult ranged from 32 to 64 days during summer flight. The incubation period ranged from 5 to 9 days.

THE INFLUENCE OF CLIMATIC FACTORS

The temperature for the year of 1921 reached a maximum of 101 degrees F. during June and a mean maximum of 86.3 for the season, which was above the normal temperature for the latitude of Gainesville. The summer was dry and hot with the exception of June which had about a normal precipitation of 5.70″, while July was above normal having a rainfall of 15.03″, and October with 6.03″ was about normal.

Since the Bean Leaf-Hopper has been recorded as reaching its optimum development during hot dry weather, it is evident that this species experienced a quite favorable season for its development, however,

the long dry periods caused much of the early beans to perish which resulted in the destroying of countless numbers of immature stages while the adults sought citrus and shade trees in quest of food.

Tipburn On Beans

It was noted after a few days colonization of the nymph stages on young bean plants, which were grown under insect proof cages, that the tips of infested plants were affected in a manner similar to that caused by spray injury, the adults and nymphs feeding on the mid-veins and branches caused them to collapse, later the tip and margin generally turned upward and took on a Vandyke Brown color as it rolled inward at the edges. The area remaining inside of this rolled margin turned to a pale brown color and, where light infestations occurred there remained small patches of green near the stem end of the leaf. In a light infestation the rolled margins of the leaves would sometimes become broken and fall off, giving the leaf a ragged appearance and still a portion of the leaf would remain green unless it continued to be infested. In severe cases the leaves usually all become dry and drop to the ground and nothing remains standing but the main stem. The kind of soil as well as sunlight did not seem to be of any importance in minimizing burning on the bean plants, hot dry weather seemed to hasten its developement while humid weather and moist soil retarded its development. Numerous variety tests were made but none showed any particular resistant characteristics except some of the pea bean varieties.

Natural Enemies

It was observed that this species was preyed upon by few natural enemies. Several species of spiders occasionally entangled an adult or nymph in their webs, and a species of mite was found feeding on the nymphs. The common small red ant (*Dorymyrmex pyramicus*) was noticed at frequent occasions as being predaceous upon the nymph stages

Commencing in July the Parisitic fungus (*Entomophthora sphaerosperma* Fresenius) was noted to be attacking both the adults and nymphs of this species. When the disease was contracted they die in several day in the adult with the wings expanded and the conidia bearing threads coalescing over the body, especially the softer or fatty parts but often covering the chitinized portions as well. The host after death turns to a pale yellowish tint, while the fungous growth or mat becomes flattened on the upper surface with the color varying from white to Nile green. The writer has experienced some success in artificially cultivating and disseminating this fungus.

Method of Control

The most difficult problem which was experienced regarding control was the wide range of host plants of E. mali. Since rotation is out of the question, and clean culture being of little value, after persuing a series of spraying experiments it was concluded that equally as much importance is to be attached to the method and kind of apparatus used as upon the formula itself. Therefore, the writer has, after a series of experiments, designed a sprayer attachment for truck crop insect control work which rendered better results for Leaf-Hopper control than any other available equipment which was first tested out with poor results. The time when the spraying was started was found to be very important as the Leaf-Hoppers attacked the plants as soon as they had formed leaves. Since the Leaf-Hoppers attack the lower sides of the leaves it would seem that only the lower sides would require an application of spray. As a matter of fact it was observed after a number of spraying experiments had been completed, where only the lower side of the leaves were being sprayed, that often nymphs and also the adults, if they did not take flight when molested, would assume their sidewise running habit and pass over the margin of the leaf to the upper side of the leaf in quest of protection and would later resume feeding when a suitable place was found which had not been thoroughly sprayed.

A New Spraying Device Designed by the Writer

This device contains three wide angle mist spray nozzles, all of which are connected to a common hose which is attached to pressure pump and sprayer tank. These nozzles are enclosed within a canvas covered cylinder at least 36 inches in length and 24 inches in diameter. This cylinder contains an opening 8 inches in width and running full length of the cylinder. The opening is turned downward and serves as a passage for the base of the plants, as the cylindrical enclosure enveloping the plants passes over the row. A wide angle mist nozzle centrally located in the top of this cylinder directs the spray downward on top of the foliage. Two wide angle mist nozzles located, one on each side of the 8-inch opening and midway between the ends of the cylinder, which are adjustable to direct the spray either inward into the row of plants or upward, thereby making it possible for the spray to make a thorough contact with the lower side of the foliage. The ends of this cylinder are enclosed with an adjustable iris curtain so that the aperature can be adjusted according to the needs and the size of the plants.

Some Advantages Over The Common Method

1. It was found to prevent escape of insects when spray was applied to the plants.

2. Preventing their escape usually resulted in their being killed by eithre contact with the spray or its colliodal vapor fumes which were formed from the combination of nicotine sulphate and whale oil soap.

3. It is adaptable in making a thorough application of spray on the smallest plants because two nozzles are adjacent to the ground; an important factor in the fall bean control work, as the leaf-hoppers colonize soon after the first leaves are formed.

4. By holding or confining spray close to the plants within the enclosure, the greatest efficiency and economy is produced by the spray, its vapor and fumes.

5. This spraying device can be operated successfully as fast as a horse usually walks. An acre was sprayed in one hour, and with power or traction sprayer it can be operated by one man.

The writer plans to add some improvements to this apparatus and also make it adjustable for dusting work as well as liquid and volatile sprays.

The following table summarizes results of some experiments where new design sprayer was used.

SPRAYED TESTS WITH CHECK ON CONTROL OF BEAN LEAF-HOPPER AND TIPBURN

Plat. No.	Spray Material	Distribution	Date Applied	100 Plants	Adults & Nymphs killed Percent	Control of Tipburn Percent
1.	Check, unsprayed	0	0	0	0	0
2.	Nicotine Sulphate (40%)	1-1000.	Sept. 15	"	90	75
3.	Nicotine Sulphate (40%) & Whale oil soap	1-1000 1 lb.	" "	61	95	89
4.	Whale Oil Soap	10 gal. H_2O 1 lb.	" "	"	71	70
5.	Bordeaux Mixture	4-4-50	" "	"	42	95
6.	Bordeaux Mixture Nicotine Sulphate	4-4-50 1-800	" "	"	85	95
7.	Kerosene Emulsion	7%	" "	"	81	66

Owing to the dry season six sprayings were applied at intervals of about a week apart. The spray material was applied at a pressure of 200 pounds. After summing up the results on spraying tests the Nicotine Sulphate and whale oil soap gave the best results with the Bordeaux mixture, Nicotine Sulphate giving the next best results.

EXPERIMENTS WITH CONTACT INSECTICIDES FOR THE CONTROL OF THE JAPANESE BEETLE (*POPILLIA JAPONICA*)[1]

By B. R. LEACH and F. J. BRINLEY *Riverton, N. J.*

During the summer of 1920, while engaged in testing various insecticides, the writers noted the fact that a soap solution killed the

[1]Published by permission of the Secretary of Agriculture of the U. S. Department of Agriculture.

Japanese beetle by contact. A series of tests were accordingly conducted during the season of 1920 and 1921 in order to determine the factors influencing the use of soap alone and combined with other materials when employed as a contact spray for the control of the Japanese beetle, and the Rose beetle (*Macrodactylus subspinosus*).

An efficient contact spray will no doubt have considerable application in the control of the Japanese beetle at this time, due to the fact that a suitable arsenical spray has not as yet been developed. The gregarious feeding habit of the beetle is also conducive to securing a large kill by the use of a small quantity of contact spray on a limited amount of foliage, since the beetles cluster thickly on grape vines, sweet cherries and smartweed, mainly feeding exposed on the upper surfaces of the leaves where they are readily wetted by a contact spray.

Materials Employed

During the course of the experimental work the writers tested the various types of soaps. These included fish oil, rosin fish oil, laundry, borax, sodium hard and soft, and potassium soft soaps. The results indicate that the type of soap is not as important as is the concentration of the spray solution although certain types of soap are better adapted to this purpose than others. Laundry soaps, for instance, when used, at the necessary concentration, will not remain entirely in solution. They tend to form a thin jelly of rope-like consistency thruout the liquid, even when agitated. This is not the case with certain grades of sodium and potassium soaps manufactured from vegetable oils, such as soja bean oil. When this soap is dissolved in hot water and diluted to spray strength the solution does not gel, but remains in solution even on cooling. It is important to use a soap which does not gel in solution at spray strength, otherwise the spray solution is

Table I. Results Obtained With Various Types of Soaps in Solution When Used Against the Japanese Beetle

Type of Soap	*Lbs. of Soap to 50 gal. water*	*P. C. Killed*	*Remarks*
Fish Oil	1–10	————	Inferior kill even at high concentrations
Rosin Fish Oil	1–10	————	"
White Laundry	2	45	Soap tended to gel.
"	5	50	Gelled badly
Yellow Laundry	2	0	Strong tendency to gel.
"	5	45	"
Borax	2	0	"
"	5	30	"
Sodium Soja Bean	2	10	No tendency to gel.
"	5	42	"
"	6	55	"
"	8	82	"
"	10	90	"
Potassium soja Bean	2	10	"
"	4	25	"
"	6	40	"
"	8	50	"
"	10	80	"

uneven in concentration and does not give a constant kill throughout the area sprayed.

The results obtained from the use of various types of soap are given in Table 1. The spray was applied during the heat of day when the beetles were active.

The results indicate that the laundry, rosin fish oil and fish oil soaps are not fitted for this purpose. It will be noted that the efficiency of the sodium and potassium soaps is in proportion to the concentration of the spray solution. In warm weather sodium soja-bean soap at the rate of 10 pounds dissolved in 50 gallons of water gave invariably 90% kill. Potassium soja-bean when used at the same concentration resulted in a slightly lower mortality.

The effect upon the individual beetle when it comes in contact with the spray is pronounced. The conspicuous coloring of the insect is obliterated and it assumes a dull grayish black appearance. The legs straighten out, no violent movement takes place and death sometimes occurs within thirty seconds. The complete mortality takes place within a few minutes. Some of the beetles fall to the ground, while others remain hanging to the leaves by their tarsal claws.[2]

Addition of Materials to Soap Solutions

During the course of the experiments a number of materials were tested in this connection alone and with the soap solutions. These materials are included in the following list:

Sodium ploysulphides	Worm seed oil
Sodium thiosulphate	Pine oil
Carbon disulphide	Lemon oil
Acetone	Toluene
Castor Oil	Sulfur
Gum arabic	Fusel oil
Methyl alcohol	Potassium sulphide
Kerosene emulsion	Linseed oil
	Nicotine sulfate

The results indicate that the materials alone were of little or no value in this connection, and when these materials were added to the soap solution they did not improve the efficiency over that of the soap alone. Seemingly of all the materials tested, only one was active; namely the *soap*. For this reason the use of rosin fish oil or fish oil soaps is

[2]During the course of the work the materials enumerated in this paper were tested against the Rose beetle (*Macrodactylus subspinosus*). The results were substantially the same as those with the Japanese beetle.

of doubtful value in this connection, because these materials themselves are mixtures of soaps and other materials, of which the soap alone is toxic.

Factors Influencing the Treatment

The experimental results indicate that temperature is the limiting factor in the use of this treatment. The best results are secured by spraying when the insects are exposed to the sun during the heat of the day. Under these conditions a consistent kill of 90% of the beetles was obtained whereas simultaneous spraying of beetles in the shade never resulted in more than 50% mortality.

In applying the material the best results are secured by using a coarse nozzle and sufficient pressure to thoroughly wet the foliage.

The sodium and potassium soja-bean soaps are now selling at 8 to 9 cents per pound and at the present price of these materials it costs from 80 to 90 cents for 50 gallons of spray.

The experimental work with these materials has been confined entirely to field tests and observations and under the circumstances no explanation can be offered at this time regarding the physiological action of the material upon the insect.

LARVAL FOOD HABITS OF THE JAPANESE BEETLE (*POPILLIA JAPONICA* NEWM.)[1]

By Loren B. Smith, *Riverton, New Jersey*

For several years it was believed that the larvae of the Japanese beetle fed largely on decaying vegetable matter in the soil.[2]

Observations made during the present season indicate that while a certain amount of humus and mineral matter passes through the digestive tract, the larvae feed principally upon the living roots of various plants.

Field Observations

During April and May, 1921, the writer observed the larvae actively feeding on the roots of rye, clover, and several of the pasture grasses. Further observations made in fields of rye disclosed the fact that in nearly all cases the larvae were congregated about the roots of the rye stools. The larvae have also been found feeding on the large tap-roots of clover, some of which were nearly eaten through between

[1]Published by permission of the Secretary of Agriculture of the U. S. Dept. of Agriculture and New Jersey Dept. of Agriculture.

[2]Davis, J. J. Green Japanese beetle. New Jersey State Department of Agriculture. Circular No. 30. p. 14. 1920.

one and two inches below the crown. The larvae do not confine their attacks to grasses and legumes, since records have now been obtained of their feeding on the roots of such plants as iris, peony, gladiolus, arbor vitae, small conifers, as well as other ornamental plants and shrubs, and also on the roots of corn, beans and tomatoes.

The first injuries to grass sod which were noted occurred in a pasture in which the abundance of the larvae was between 150 and 200 to the square yard. Areas were injured to such an extent that the sod could be easily rolled up with the fingers. Many of the plants which did not have the roots entirely eaten off by the grubs were killed by the hot, dry weather which ocurred later in the season. Many weeds and coarse rooted grasses do not show any appreciable effects from the feeding of the larvae, whereas the finer rooted species such as blue grass and red top are killed. For this reason it is probable that the most important injury by the grubs will not usually result in the destruction of the sod, but rather in the killing out of the more desirable species of grasses for pasture or hay purposes, and their being replaced by less desirable species.

Golf courses offer particularly favorable situations for the development of *Popillia japonica* larvae. The Country Club course at Riverton, New Jersey was found to be generally infested with the grubs early in the Autumn of 1921. On the fairways and in the rough the infestation was variable, on an average of a number of diggings less than fifty larvae were found to each square yard. On several of the putting greens the larvae were very numerous, as high as one grub to the square inch being found. The grass was killed in limited areas on someof the greens. That the greens were not more seriously injured was probably due to the fact that they were regularly watered and rolled. Aside from the direct injury to the grass roots, the playing surface was rendered soft and spongy by the burrowing of the insects in the soil. It was noticeable that the most severe injury to the grass occurred on the higher portions of the greens and especially about the margins. These would probably be the places which would receive the least water when the greens were sprinkled. Much of the feeding on the greens was done close to the surface of the ground, the larvae in most cases occurred between ½ inch and ¾ inch deep.

Feeding Habits

The feeding habits of the larvae have been observed many times both in the laboratory and in the field, and have been found to differ somewhat from those of certain of our native species. The larva

forms a cell in the soil slightly larger than its body and feeds on the fine rootlets at the top or bottom of the cell. The grubs usually follow the course of the rootlets until these are consumed before attacking others. It is this habit of feeding which has prevented the injury to grass from being extremely serious, since it is only in areas of heavy infestation that many plants are found which have all of their roots destroyed. It also follows that in areas which suffer from drought the injury has been the most noticeable and severe.

The general movements of the larvae in the soil are vertical, whereas the larvae of *Cyclocephala immaculata* and *Anomala* sp., which are abundant in this region, usually feed and move in a direction parallel with the surface of the ground. During the seasons when the *Popillia japonica* larvae are feeding they occur in the soil at depths varying between ½ inch and 3 inches. For a short time before the grubs descend on the approach of cold weather in the autumn and again during the period immediately preceding pupation, the depth at which the various individuals are found is more uniform.

Thigmotropism

The larvae are positively thigmotropic to living roots and if these are not available, to stones, sticks, or to the bottom or sides of the breeding cage. The larvae have been found abundantly beneath stones in the field and for a distance of two or three feet from these stones no larvae could be found, although at a distance of five or six feet from the stones there would be twenty to twenty-five larvae to the square yard. In a young peach orchard which was cultivated the previous season and allowed to remain fallow over winter, there were numerous chickweed plants growing in the Spring of 1921. In the spaces between these plants the ground was bare. Fifty plots, each three square feet in area, were examined where no vegetation occurred and no larvae were found. On the removal of fifty chickweed plants an average of 7 larvae were found at the roots of each plant

Examination of the Contents of the Fore Intestine

Dissections were made of a large series of larvae collected in grass sod and the contents of the fore part of the alimentary canal were carefully removed. It was found that the material eaten by the insects was composed of small soil particles, fresh plant tissue, and small pieces of plants which were partially decomposed. In order to determine the approximate amount of plant tissue as compared with the mineral matter eaten by the larvae, four samples of about five grams

each were collected from the fore intestines of the grubs. These were dried, weighed, ignited and weighed again and the loss from ignition considered as representing the approximate proportion of plant tissues, by weight to the total material found in the fore intestines of the insects. The loss by ignition of the soil from which these larvae were collected was about equal to the per cent of ash in the grass roots and for our purpose these factors can be considered to offset each other. These figures indicate that plant tissues constitute about 67.33 per cent. by weight of the total material consumed by the larvae.

ANALYSIS OF MATERIAL EATEN BY LARVAE OF *P. japonica*

Total weight of food collected	21.4134	grams
Dry " " " "	15.4769	"
Ash remaining after ignition	5.0556	"
Loss from ignition	10.4213	"

Examination of the material contained in the fore part of the alimentary canal indicates the soil particles and pieces of plant tissue to be relatively uniform in size. The greatest variation occurred in those tissues which were partially decomposed. The following data on the extremes in size of particles found in the fore intestine are in each case based on fifty measurements:

Fresh plant tissue	minimum length	0.45 mm.
	maximum "	1.22 mm.
Fresh plant tissue	minimum width	0.25 mm.
	maximum "	0.36 mm.
Soil particles	minimum length	0.72 mm.
	maximum "	1.125 mm.
Soil particles	minimum width	0.327 mm.
	maximum "	0.875 mm.

In order to determine the relative number of pieces of fresh plant tissue, decaying vegetable matter and particles of soil composing the aggregate in the fore intestines of the larvae, determinations were made of the number and character of the particles obtained from twenty-five grubs. The larvae were collected from grass sod May 20th, killed by dropping in boiling water, and dissected immediately afterward. To separate the fresh plant tissues from those which were dead or partially decayed, it was necessary to stain and compare the cellular structure of the pieces found in the insect with the structures in fresh root tissues taken from the plants where the larvae had been feeding. The following tabulated statement indicates the approximate number and character of the particles of material found in the fore intestines of the larvae:

Total number of pieces of fresh plant tissue	1375	64.3%
" " " " " decayed plant tissue	419	19.0%
" " " " " mineral matter	344	16.0%

From the figures given it will be seen that from twenty-five larvae approximately 84.0% by volume of the material eaten was vegetable matter, and 64.3 per cent. of the total amount of material consumed was from the roots of living plants.

In an experiment started May 2, 1921, 200 three-ounce tin boxes were filled with the following materials and one larva placed in each tin. The object was to note the effect on the larvae, as shown by the mortality, of the presence or absence of living plant roots in the soil. Fifty tins were filled with rich sifted garden soil. Fifty tins were filled with sifted subsoil taken at a depth of four feet, containing 1.45 per cent of organic matter. Fifty tins were filled with subsoil to which was added pieces of partly decayed grass roots from which the soil had been washed. Three weeks after the experiment was started the tins were examined and the number of live and dead larvae were noted. Replicate series were conducted in the autumn using young larvae. The results obtained were similar. The following tabulated data gives the results obtained.

	Number dead in three weeks.	Per cent.
50 larvae placed in garden soil	27	54
50 larvae placed in subsoil	44	88
50 larvae placed in subsoil and decayed roots	22	44
50 larvae placed in garden soil and fresh sod	3	6

The data presented indicate that while the larvae may survive in the soil for a certain length of time without living roots upon which to feed, their presence is extremely important to the development of the grubs. This fact applies particularly to the summer, early autumn and spring, during which periods most of the feeding is done. This has also been borne out in our rearing cages where entire series have died for no apparent reason other than starvation when sod was not added to the soil.

Summary

In the past it was generally believed that the larvae of *Popillia japonica* fed largely on decaying organic matter in the soil. Observations made during the season of 1921 indicate that during the spring and autumn, when most of the feeding is done, live plant tissues constitute between 60 and 70 per cent of the food of the grubs.

Injury has been noted to grass sod in pastures, golf courses, especially on the putting greens. In some places the grass was killed in patches. It is probable that the most serious injury to grass land will occur through the destruction of the finer rooted species, particularly blue grass and red top.

The larvae form cells in the soil and feed on the plant roots either at the bottom or top of the cell. The movements of the larvae in the soil tend to be vertical and most of the feeding is done between ½ inch and 3 inches below the surface.

The larvae are positively thigmotropic to roots, stones, sticks or to the bottom or sides of the breeding cages.

Analysis of the material found in the fore intestines of the larvae indicates that plant tissues constitute about 67.33 per cent by weight of the total material eaten. When this material was examined microscopically it was found to be composed of somewhat uniformly sized pieces of fresh plant tissue, pieces of decayed plants, and particles of soil. The fresh plant tissue, on the basis of the number of pieces, constituted 64.3 per cent of the aggregate.

Experiments conducted in the laboratory indicate that the mortality of the larvae is greatly increased when they are in soil or subsoil without access to living roots, compared with the mortality occurring when they are in a mixture of soil and fresh sod.

EULIA MARIANA FERNALD, A NEW APPLE FEEDER IN PENNSYLVANIA AND SOME RELATED FORMS ON APPLE

By S. W. Frost, *State College, Pennsylvania*

This species has not been found as abundant as the red banded leaf-roller, *Eulia velutinana* Walker which was previously referred to in the Jl. Econ. Ent. Vol. XIII 6, 1920. Although it is not as abundant it has been repeatedly collected, feeding both on the foliage and the fruit of the apple. An insect survey of Pennsylvania made during the summer of 1921 revealed the species in several different counties, indicating that it is well established in this state and that it has apparently become adapted to the apple. Engel[1] (1908) records it from New Brighton, Pa. He notes that it was rare at that time and found it at rest on trees in the forest. Fernald[2] (1882) records it from Maine, Massachusetts and New York as a feeder on Oak. It has also been recorded as a feeder on Blueberry, Vaccinium by Smith[3] (1910). The larvae resemble the red banded leaf-roller in appearance, being entirely yellowish green in color and about three quarters of an inch long when full grown. They are similar in habits, the majority winter as pupae and the adults issue in the spring, laying their eggs in masses on the trunks and larger branches of the trees.

Since the original note on *Eulia velutinana* Walker, as a pest of apple, it has been found that the species passes the winter as pupae and

not as adults and that there are three complete generations. The seriousness of this pest has been found considerably more than it was thought to be at first. It is now considered as one of the most important problems of the fruit growers of Pennsylvania, causing a considerable amount of scarring and side injury to the fruit. The life history of this species has been worked out in considerable detail and an extension circular from State College is in preparation and will be ready for release in a short time. Bull, 169 from the Penn. State College deals with this species as well as other leaf-rollers and bud-moths of the apple in Pennsylvania.

A third species of this genus *Eulia quadrifasciana* Fernald has been reported from New York state as a pest on apple but has not been found injurious in Pennsylvania. It has been recorded from Canada, Maine, New Hampshire, Massachusetts, New York, Pennsylvania and Delaware and no doubt has a general distribution throughout the North-Eastern part of the United States. As far as the writer is aware it feeds on apple alone.

It appears that the genus *Eulia* includes many injurious leaf-rollers of apple and that there may have been, in the past, some confusion of species. It is hoped that this note may be of value in calling to attention the various species working on apple and that more concentrated work may be conducted with these feeders. In Pennsylvania it is very evident that the genus *Eulia* includes the serious leaf-rollers and the marked difference in the life histories of these species make their control different from the control of the species of the genus *Cacoecia* which apparently are more injurious in New York state and portions of the country further North.

Thanks are due Mr. August Busck for the identification of these species.

1. Engel, Henry. Annals Carnegie Museum, Vol. V No. 2 (1908).
2. Fernald, C. H. Trans. Am. Ent. Soc. V (1882).
3. Smith, J. B. Insects of New Jersey (1910).

Scientific Notes

The European Nitidulid beetle. *Heterostomus pulicarius* Linn., has caused considerable damage to strawberry plantations in Columbia County this season and is present in Saratoga, Albany, Niagara and Schoharie Counties in New York State. In 1921 Mr. H. Morrison collected specimens of this beetle on the grounds of the Arnold Arboretum near Boston. On May 2, 1921, a single specimen was collected at Milford, Conn., by Mr. M. P. Zappe. W. E. B.

The Anomalas collected at New Haven, Conn., in 1920, and again in 1921, have recently been identified as *Anomala orientalis* Water. This insect is a native of Japan and some ten years ago caused much damage to sugar cane in Hawaii, but parasites were introduced and proved successful in reducing the numbers of the

beetles below the destructive point. In Connecticut a few specimens only of this beetle were found on grass and weeds, on the edge of a nursery where new residences are being erected.
W. E. B.

Feeding Punctures of Insects. At the meetings in Toronto, last year, I was asked the nature of the feeding puncture of the greenhouse whitefly (*Trialeurodes vaporariorum* West.) and was unable to give a definite statement regarding it. As stated at that time, the aphids in most cases select the soft bast of the vascular bundle. Allen has shown that the middle lamella consists really of two layers, one contributed by the secretion of each of the daughter protoplasts. The cell plate does not constitute the middle lamella but splits to form the plasma membranes of the daughter cells. It is along the cleavage plane of the middle lamella that the setal tract of the plant louse proceeds and along this tract the setal secretion is laid down. While the feeding does not, therefore, injure the mesophyll cells this secretion often has a distinct reaction, the cells becoming enlarged, oedematous and devoid of chloroplasts. The reaction of this secretion appears to vary with different species and different hosts. Hargraves has studied the punctures of the greenhouse whitefly and it seems evident that this insect selects similar tissues for feeding. *Trialeurodes vaporariorum*, then, should be grouped with the commoner aphids as to tissue selection and not with such forms as the red spiders which feed on the contents of the epidermal cells or a few cells immediately underlying them.

A. C. BAKER,
U. S. Bureau of Entomology

Sea Coast Flea Beetle (*Disonycha maritima* Mann.) **Injurious to Sugar Beets in Sacramento Valley, California.** While conducting investigations on the beet leafhopper (*Eutettix tenella* Baker) in the Sacramento Valley, Mr. G. Wright, formerly Agriculturist of the Alameda Sugar Company, and the writer visited some beet fields which were seriously injured by one of the Halticini, *Disonycha maritima* Mann. The foliage was riddled with holes and from 1-2 dozen beetles were found between the petioles at the crown of the beet or below lumps of soil near the beet root. The beetles also gnawed holes in the beet root. The pest was generally distributed over 157 acres of sugar beets near Knights Landing on May 27, 1919. The beet fields were visited again on June 16 and 22, but the beetles were rarely found. Trips were taken to the same fields in July and August but the beetles had disappeared. During 1920, the same beet fields were visited on May 26-27, with Mr. A. J. Basinger, formerly Entomologist of the Alameda Sugar Company, and the beetles were commonly taken but the injury was not so serious as during the preceding spring. During the summer, however, the beetles again diasppeared. Although all beet centers were visited in the Sacramento Valley during the two seasons it was only in the Knights Landing beet district that this insect was found.

According to the literature nothing is known of the native food plants of this beetle. Mannerheim (Bul. der Naturforsch. Gesellsch. in Moscau, Bd. 16, p. 311, records the habitat in California on plants along the sea coast. Horn (Amer. Ent Soc. XIV, 1889, pp. 206-207) states that *D. maritima* occurs in California and Nevada Fall (Cal. Acad. Sci. VIII, 1901, p. 157) mentions one example taken at Pomona California in October. Van Dyke (Ent. News XXX, 1919, p. 244) found in the cleft of the rocks along the crest of the San Bruno hills which form the southern boundary of San Francisco County, fair assemblages of *D. maritima* during the winter.

Specimens were kindly determined for me by Professor E. C. Van Dyke.

HENRY H. P. SEVERIN, Ph.D.
Calif. Agr. Exp. Sta.

The Distribution of the Pink Bollworm of Cotton, *Pectinophora gossypiella* **Saunders, in Porto Rico.** In July, 1921, Mr. Ignacio L. Torres, a Sub-Inspector of Agriculture, found a caterpillar injuring cotton bolls in plants at Humacao, Porto Rico, which on examination proved to be the pink bollworm, *Pectinophora gossypiella* Saunders, and soon after the pest was found thruout the commercial cotton growing section of the island. A careful survey of the distribution of this insect was made during the past winter and spring (1922) by Mr. J. D. More, formerly of the pink bollworm eradication force of the Federal Horticultural Board, and the writer.

Cotton plants or trees often occur along roads and in the yards about houses in most parts of Porto Rico, but are sometimes quite rare, especially in the coffee-growing mountainous districts of the interior. On such semi-domestic plants, the pink bollworm occurs all around the island near the coast, except around Mayaguez on the west, but it has not been found in the interior even a few miles from the ocean. It was not found on plants collected at the following places: Rio Piedras, Carolina, Canovanas, Rio Grande, Mameyes, Guaynabo, la Muda, Caguas, Cayey,

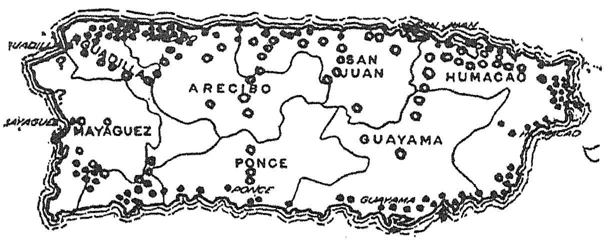

Fig. 16.—Map of Porto Rico, showing Distribution of the Pink Bollworm of Cotton, *Pectinophora gossypiella* Saunders, in the Spring of 1922, as determined by J. D. More and George N. Wolcott. Black dots indicate infested plants, circles uninfested plants.

Comerio, Bayamon Plantaje (Point Salinas), Toa Alta, Vega Alta, Manati, Ciales, Villalba, Garrochales, Utuado, Adjuntas, 14 km. north of Yauco, Lares, San Sebastian, Maricao, Mayaguez (Cerro de las Mesas), and Hormigueros. It is present thruout the commercial cotton growing region, Aguadilla to Arecibo, and has spread further into the interior here, to Moca on the west and to Bayaney on the east (15 km. from the coast) than anywhere else.

The most heavily infested plants seen were on the beach south of Maunabo, in the southeastern part of the island, and it appears possible that its presence on the east and southeast coast represents a separate infestation, either from moths blown from adjacent islands, or seed washed ashore. It is supposed that the pink bollworm was brought to Porto Rico in infested seed from St. Croix before its presence had been reported from that island, and thus established in commercial plantings at Sabana Grande (Lajas), Aguadilla to Arecibo, at the Laguna de Tiburones near Vega Baja, and on plants near the gin at Martin Peña. The infestation eastward along the coast to Point Cangrejos and Loiza can be traced to seed brought from the gin, as most of the plants here are uninfested. The next infestation to the east is on the beach between Mameyes and Luquillo, and altho in the hills between Luquillo and Fajardo the cotton is uninfested, approaching Fajardo and extending along the east and south coast as far as Yauco, practically every plant is infested. On the west coast, some of the plants around San German and Cabo Rojo were infested

and north of Añasco and at Coloso the infestation is light or doubtful, the interior of some of the bolls being characteristically stained, but no insects found. On the north coast outside of the cotton district, infested plants have been found at Barceloneta, Vega Baja and on the beach at Dorado, The pink bollworm has also been found in Vieques Island to the east of Porto Rico and in Mona Island to the west.

GEORGE N. WOLCOTT

The Use of Poisons as Insecticides in The French Colonies. In an article in the *Comptes Rendus des Séances de l'Academie d'Agriculture de France* for the 29th of March, 1922, Veterinary Major H. Velu gives a very interesting statement of French laws which have operated to prevent the use of arsenical poisons, not only in France, but in her colonies. He shows that the use of these poisonous substances has given rise to no fatal accidents in America, and that the experiments made by the New Hampshire station from 1912 to 1916 have irrefutably established the fact that the dangers of the use of such poisons are greatly exaggaerated. He cites the use of arsenical baths against the Texas fever tick in the United States, and gives figures showing that in 1919 250,196 gallons of arsenical solutions were used, in which 48,530,229 domestic animals were bathed. He states that by the use of arsenious acid and its derivatives, soluble or insoluble, immense regions in California, previously deserted, have been transformed into productive country. Thanks to arsenicals, he says, California inundates all the markets of the world with its fruits; and, thanks to the arsenicals, English—and Spanish—speaking countries produce cattle of the first quality. He shows that the French are away behind and that the French colonists are ignorant, as a rule, of spray formulas and animal bath formulas. He states that it is quite evident that fruit orchards cannot be developed in North Africa unless they can be easily protected against injurious insects; and that high grade domestic animals cannot be raised without arsenical baths. He shows that the employment of arsenicals in agriculture in France is regulated by the law of the 12th of July, 1916, a revision of the law of 1845, by the decree of the 14th of September, 1916, and the Ministerial Circulars of the 14th of January, 1917, and the 27th of April, 1921. These laws allow the sale and the employment of insoluble arsenical compounds exclusively for the struggle against the parasitic diseases of plants. Contrary to the English law entitled "The Poisons and Pharmacy Act" of 1908 and the modifying texts, they do not apply in any case to soluble compounds however indispensable for use against the parasites of domestic animals. They tolerate in a provisional way the use of soluble arsenicals in agriculture since the spring of 1922. He shows that in June, 1921, the Academy of Medicine opened the question once more and Professor Cazeneuve argued again against the free use of arsenicals in agriculture.

He shows that in France the economic side of the question is possibly secondary or even negligible, but it is quite different in the colonies, where the prohibition of arsenicals, and even soluble arsenicals, will bring disaster and will greatly reduce the value of the products of the colonies.

The French laws are applicable to Algeria, to the colonies and to the countries of the protectorate. This puts the French colonies at a great disadvantage with the English colonies and the Americans, who, with their essentially practical spirit, have not hesitated to permit arsenical baths and all of the arsenical sprays whether soluble or not; and the French rules are anti-economic and indeed superannuated.

"Summing up," he says, "the question resolves itself down to whether a few accidents which have happened in France owing to the employment of arsenicals are sufficiently important to justify in the colonies the depreciation of extremely fertile

regions, the abandonment of fruit culture and stock raising, by the absolute or relative prohibition of methods judged by the whole world to be indispensable to agriculture, horticulture and stock raising, awaiting the day when modern biological methods will give us the beautiful results which we have a right to hope for, notably by the destruction of plant enemies through the help of beneficial exotic insects and the suppression of piroplasmoses by vaccination." L. O. H.

American Foul Brood. To transfer bees from infected hive to clean hive by the smoke method. Prepare a clean hive body with full sheets foundation. Place on this hive body a ventilated inner cover which may be made by cutting out about one-third of the solid cover or bee escape board and tacking wire screen over the opening to make it bee-tight.

When ready to transfer bees from infected brood chamber to clean hive body in new brood chamber, which should be done during a honey flow, go to the infected colony sometime during the middle of the day when bees are working in the fields and remove the queen. Place her in a cage with a little candy and take care of her until ready to return her to the bees in the afternoon.

About sundown take your clean hive body and go to the infected colony. Remove the inner cover from the infected colony and place the clean hive body with full sheets of foundation and ventilated cover on top of the infected colony. Reduce the entrance to the infected colony to about $\frac{3}{8}$ inch x 2 inches or 3 inches. Have your smoker well filled and giving a good dense cool smoke.* Smoke the bees gently through the entrance to the old brood chamber, being careful not to use too much smoke or work the smoker hard or fast enough to make the smoke hot—dense cool smoke applied almost continuously gives the best results. The ventilated inner cover on the clean hive body on top of the old brood chamber will allow the smoke to escape and the bees not being able to escape at the entrance will leave the combs in the old brood chamber and attempt to escape at the top of the clean hive body. By smoking gently for ten or fifteen minutes almost all the bees will desert the old brood chamber and cluster on the frames, top and sides of the clean hive body. You can tell pretty well when all the bees are out of the old brood chamber by looking into the clean hive body through the wire screen cover. When you are quite sure the bees are all out of the old brood chamber close the entrance and set it, with the clean hive body still on top, to one side and place clean bottom board on the old stand. Now gently lift the clean hive body, bees and all, off the old brood chamber and place it on the clean bottom board on the old stand. If any bees are left on top of the frames of the old brood chamber after removing the clean hive body they may be brushed off and placed in front of the new brood chamber. Replace the cover and the old brood chamber, closing it up bee-tight. By this time the bees in the clean hive body, which is now your new brood chamber on the old stand, will have quieted down so that you may give them back their queen which you have in the cage. This should be done by removing the stopper from the cage so the queen can escape and pushing the inner cover over just enough to lay the cage on top the frames. If the bees are still clustered on top the frames so as to make it impossible to move the cover far enough to permit placing the cage on top the frames without allowing bees to escape, push the open cage in under the frames at the entrance, but you should watch the entrance for four or five minutes to see that the queen does not come out as it sometimes happens that the queen not finding any bees on the bottom board and feeling that she is in a strange place runs out at the entrance and gets lost.

If you have only one infected colony to treat you cannot very well save the healthy brood in the old brood chamber which you left closed up beside the clean hive body

or new brood chamber on the old stand. Then take it into the house at once and cut out the old combs and render them into wax as soon as possible so as to get rid of any possibility of infection from that source. Any bees found in the old brood chamber when opened in the house should be destroyed. Do not allow a single bee to escape as it might carry infection to another colony or to its own colony if the bees had cells drawn out enough for storing honey.

If you have two infected colonies to treat, transfer the stronger first and place the old brood chamber over queen excluder on the weaker one. Three weeks later remove the queen excluder and put a bee escape in its place. When the old brood chamber is clear of bees, remove it, close it up bee-tight and put it in the house Then transfer the second colony to a clean hive body in the same manner as the first and close up the old brood chamber and put it in the house. Then cut out and render all combs into wax at the same time. Do not let any bees from these old brood chambers escape to return to the hives.

If you have several colonies to be treated you may use two or three of the weaker ones to stack up the brood chambers from treated colonies to save the healthy brood and strengthen the weaker ones. The old brood chambers from infected. colonies may be placed on these weaker colonies over queen excluder as they are taken away from the treated colonies, stacking them up four or five stories high Three weeks after the last brood chamber was put on one of these colonies, the old brood chambers may be removed one at a time by the use of a bee escape until the colony is reduced to one brood chamber, and then bees transferred into clean hive body as described.

If any of the "stackup" colonies have more bees than one brood chamber will hold when taking off the old brood chamber, it will facilitate the work to put on empty super between the brood chamber of the "stackup" colony and the last of the old brood chambers to be removed to give clustering space for the bees. Put bee escape over the empty super and next to the old brood chamber to be removed. This empty super should not be allowed to remain on more than a day or two or the bees will build comb in it. If ready to transfer the bees to a clean hive body as soon as the last of the old brood chamber has been removed, which is the best time to do so, set the super with bees clustered in it to one side until you have transferred the bees from the old brood chamber to the clean hive body, then the bees in the empty super may be dumped in front of the clean hive body on the old stand and they will run in.

All the old brood chambers are taken into the house and combs cut out and rendered into wax and the hive bodies, bottom boards, inner covers, treated by burning out and the frames boiled in strong lye water to clean and destroy germs before using again.

This method of transferring bees from infected brood chamber to clean hive makes use of the same principles as are used in shaking or brushing bees from the combs, but is free from the greatest objections raised to shaking or brushing. The principal advantage of the smoke method is that the transfer of the bees is made without fuss or mess—no infected combs exposed at any time—no honey scattered around to be gathered up by bees—no demoralized bees scattered around to get lost and possibly enter the wrong hive carrying the disease.

If the work is done carefully, as it should be done, there will be no bees outside the hive at any time, except a very few on the outside of the clean hive when it is removed from the old brood chamber and placed on the clean bottom board. These may be brushed off and placed at the entrance and they will go in the clean hive.

W. L. Walling
Hardin, Montana

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, provided that at least 100 reprints be ordered at full price rates; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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Have we reached the limit in methods of poisoning forest trees for protection against leaf eating caterpillars? This question has been raised by the remarkably successful results of last season in poisoning the catalpa sphinx in Ohio and the fact that aeroplane dusting is being tested in New Hampshire for the control of the Gipsy Moth. Those familiar with the early work against this latter insect will recall the hand and low powered equipment used at that time and the manifest disproportion between the apparatus and the size of the undertaking. Long strides have been made since those days and the present high pressure outfits with long lines of hose have greatly increased the range and efficiency of such treatment. There are obvious limitations even to these methods. It has been felt in the past that direct remedial measures were impracticable under forest conditions and such may always prove to be the case excepting, possibly in areas where there are unusually high values, as for example within relatively short distances of great centers of population. On the other hand, it is becoming increasingly apparent that forests must be better protected or there will in the near future be a dearth of wood and wood products, not to mention the part these growths play in modifying stream flow and tempering climatic conditions. There is a possibility of the economic entomologist invading the air and working out a practical method of checking by artificial means unusual outbreaks of leaf feeders, possibly native as well as introduced. Wide spread depredations of this character, it is generally conceded, result from a disturbance of natural relations and if this is the case, it does not seem unreasonable to believe that a moderate to somewhat thorough checking of the outbreak at its center would result in reducing the pests to such an extent that natural agencies would take care of the remainder. In other words, a somewhat superficial and from

an orchardist's standpoint unsatisfactory type of poisoning may give all the protection needed in wild areas and if this should prove to be the case and could be clearly established, it might be entirely practicable to provide for a system of artificial checks which would do much toward maintaining a normal relationship between insect and plant life. The aeroplane with its distribution of the dust from above affords a ready means of placing the poison on parts of trees preferred by a number of destructive leaf feeders. The possibilities of any such method can be determined only by large scale work with a number of species and with this in mind we endorse the work in New England and express the hope that it is only the beginning of a serious attempt to determine possibilities along these lines.

The apple red bug (*Heterocordylus malinus* Reut.) whose distribution has been generally known as the northeastern states is quite common in various parts of Iowa and has been reared from Crataegus and apple at Ames this year. There are specimens in the Iowa State College collection taken at Ames as early as 1897, twelve years before the species was described by Reuter from New York. The writer's observations in Iowa as well as in New York indicate that Crataegus is the preferred host and probably the original food plant of this species.

WALTER H. WELLHOUSE

Infective Beet Leafhoppers (*Eutettix tenella* Baker) **do not Transmit Curly Leaf Daily.**—An infective beet leafhopper which completed all of the nymphal instars on a blighted beet does not transmit curly leaf daily. Three infective males, bred from eggs deposited by infective adults, passed through the last moult on July 30, 1919 and were confined in three cages. In the first cage a male was provided with a healthy beet daily; in the next experiment a healthy beet was put in the cage with the hopper at the end of every second day, and in the last experiment another male was allowed to feed, alternating daily, on a curly leaf and healthy beet. The work was conducted out-of-doors at Manteca situated in the northern part of the San Joaquin Valley. Five sugar beets developed curly leaf of 49 beets used in the experiment.

In the next experiment 1, 2, 3, 4 and 5 infective males which completed all of the nymphal stages on a blighted beet were confined in five cages in the greenhouse at Berkeley. A healthy beet was placed in each cage daily. When a leafhopper died, another was put into the cage, except in the one containing a single specimen. The experiment extended over a period of 54 days from November 1–December 24, 1920 and was discontinued when the single male died. The results follow:

One infective male transmitted curly leaf to 3 beets (5.5%) in 54 days.
Two infective males transmitted curly leaf to 10 beets (18.5%) in 54 days.
Three infective males transmitted curly leaf to 31 beets (57.4%) in 54 days.
Four infective males transmitted curly leaf to 28 beets (51.8%) in 54 days.
Five infective males transmitted curly leaf to 34 beets (62.9%) in 54 days.
Mean maximum 78.9 F., mean minimum 61.7 F., mean 70.3 F. temperatures.

HENRY H. P. SEVERIN, Ph.D
Calif. Agr. Exp. Sta.

Current Notes

Mr. Paul M. Gilmer has been appointed assistant in entomology and economic zoology at the University of Minnesota.

Prof. E. W. Stafford of the Mississippi Agricultural College is teaching entomology at Purdue University during the present summer season.

According to *Science*, Oberlin College conferred the honorary degree of doctor of science on Dr. Vernon L. Kellogg on June 21.

According to *Science*, Dr. R. P. Bigelow has been promoted to the professorship of zoology and parasitology at the Massachusetts Institute of Technology.

According to *Experiment Station Record*, Mr. John H. Harman has been appointed extension specialist in entomology at the Michigan College and Station.

According to *Experiment Station Record*, Mr. Clarence E. Mickel has been appointed assistant in economic entomology at the Minnesota University and Station.

Mr. W. V. Balduf of the Ohio Agricultural Experiment Station, Wooster, Ohio, has been appointed assistant professor of entomology at the University of Illinois.

The following temporary appointments have been made in the Bureau of Entomology: W. D. Mecum, Madison, Wis; J. M. Reilly, Kingsville, Tex; H. L. Weatherby, Birmingham, Ala.

An extension has been made this summer to the Aylmer, Quebec, laboratory, Division of Forest Insects, in order to carry on additional biological studies.

Miss Mabel Colcord, Librarian of the Bureau of Entomology, attended the annual-meeting of the American Library Association at Detroit and Ann Arbor, Mich., June 26.

Prof. John J. Davis, Lafayette, Ind., visited Washington, D. C., the first week in aJune to confer with officils of the Bureau of Entomology on insect problems of inter, state interest.

Mr. W. S. Abbott, who is in charge of the Insecticide Testing Station at Vienna, Va. will speak before the Insecticide and Disinfectant Manufacturers' Association in Chicago, June 12-13.

According to *Science*, Dr. Vernon L. Kellogg, permanent Secretary of the National Research Council, gave the annual Phi Beta Kappa address at the University of Virginia on June 13.

Mr. H. R. Painter of the Bureau of Entomology visited the Ohio Station recently in connection with making records on the date of seeding wheat plots on the severa district and county farms.

Science records the death of Dr. Alfred G. Mayer, director of the department of marine biology of the Carnegie Institution. Dr. Mayer died June 25, at Key West, Fla., aged fifty-four years.

Mr. A. F. Burgess visited New Haven on June 5 for a conference over extending the gipsy moth quarantine on account of the additional territory found infested by the scouting operations of the past winter.

The Mexican bean beetle is doing considerable injury in many sections of Tennessee, it being present in some 36 counties, with damaging infestations.

Dr. E. D. Ball, Director of Scientific Research, U. S. Department of Entomology, was scheduled to speak at the Ohio Agricultural Experiment Station, Wooster, Ohio, June 22, on "The Place of Agricultural Research in National Development."

According to *Experiment Station Record*, a new quarterly entomological journal will be published at Helsingfors, Finland, under the name of *Notulae Entomologicae*. The initial number has just appeared, and contains several original articles, abstracts and necrological notes.

According to *Science*, Prof. J. G. Needham, head of the department of biology and entomology in Cornell University, is to exchange for the next college year with Dr. William A. Hilton, of the department of zoology, Pomona College, Claremont, California.

The Bureau chiefs gave a luncheon at the Cosmos Club, Washington, D. C., May 11, in honor of the fifty-sixth birthday of Secretary Wallace. Entomologists present were Drs. E. D. Ball, L. O. Howard and C. L. Marlatt. Dr. Howard acted as toastmaster.

Dr. J. K. Haywood, Chairman of the Insecticide and Fungicide Board was scheduled to address the Disinfectant Manufacturers' Association at Chicago, June 12 and 13, on "The Work of the Bureau of Entomology in Connection with the Enforcement of the Insecticide Act."

According to *Science*, Dr. C. P. Gillette, director of the Colorado Agricultural Experiment Station, delivered at the Denver Public Library on June 6, a lecture on "Heredity and the Improvement of Man" under the auspices of the Genetic Foundation of Colorado.

The following transfers are announced in the Bureau of Entomology: B. L. Boyden, sweet-potato weevil eradication, from Daytona to Tampa, Fla; W. H. Merrill, MacCleney to Tampa, Fla; E. R. Barber, southern field crop investigations to tropical and sub-tropical fruit insect investigations, effective June 1.

According to *Science*, Mr. Hugh C. Huckett, a graduate student at Cornell University, has been appointed entomologist for the newly-established laboratory for the study of vegetable crop pests on Long Island, to be maintained from State funds under the joint direction of the State Agricultural Experiment Station and the State College of Agriculture.

Mr. G. M. Stirrett, who recently graduated from the Ontario Agricultural College, has accepted a position with the Purdue Experiment Station for the summer, and this fall at the beginning of the school term, will become associated with the Department of Entomology, Purdue University, as graduate assistant.

Mr. C. M. Smith, assistant chemist, has been detailed for several months to the Bureau of Entomology laboratory, Tallulah, La., to study the chemical and physical properties of calcium arsenate used in the control of the cotton boll weevil, with the idea of developing a more satisfactory product.

Mr. G. F. Moznette of the Bureau of Entomology, who is located at Miami, Fla., has recently been elected an honorary member of the California Avocado Association, in recognition of the service he has rendered the industry in the United States by his work with the insect enemies of the avocado.

Mr. J. C. M. Gardner, Rhodes Research Scholar, who is proceeding to India to join the Indian Forest Service, is spending several days at headquarters. He has been visiting various entomological centres in the United States, and before coming to Ottawa, spent some time with Mr. R. Hopping, in charge of our Forest Insect work in Bristish Columbia.

According to *Science*, the University of Maryland at its commencement on June 10, conferred the honorary degree of doctor of science upon Eugene Amandus Schwarz, honorary custodian of Coleoptera in the U. S. National Museum. Dr. Schwarz began official work as a specialist in Coleoptera for the Division of Entomology under the U. S. Commissioner of Agriculture in 1878.

Mr. William Moore of the Japanese beetle laboratory at Riverton, N. J., spent a week in Birmingham, Ala., going over insecticide tests with N.F. Howard. A large series of new combinations is being tested at the present time, in addition to the standard series of arsenicals which Mr. Howard is now testing, both for insecticide injury and insect control.

According to *Science* the gold medal of the Linnaean Society of London, which is given in alternative years to a botanist and a zoologist, was this year awarded to Prof. E. B. Poulton, at the anniversary meeting on May 24. In making the presentation, the President, Dr. A. Smith Woodward, referred to Prof. Poulton's long labors in entomology, and his keepership of the Hope Collection at Oxford.

Mr. R. H. Van Zwaluwenburg, formerly of the Bureau of Entomology and now entomologist of the United Sugar Companies of Los Mochis, Sinaloa, Mexico, has gone to Cuba to collect specimens of the tachinid parasite of the sugar-cane moth borer for introduction into Mexico. This parasite has already been introduced into Louisiana by the Bureau. Mr. Van Zwaluwenburg is co-operating with the sugar-cane insect laboratory at New Orleans.

According to *Experiment Station Record*, the New York State legislature made an appropriation for the purpose of studying the problems of truck crop growers on Long Island, the work to be under the joint direction of the State Station at Geneva and the New York State College of Agriculture. The act carries an appropriation of \$45,840 to provide for the purchase of a tract of land, the erection of a greenhouse, the purchase of equipment and the employment of an entomologist and a plant pathologist to be permanently located at the Station.

Dr. Charles P. Alexander, of Urbana, Ill.· has been elected assistant professor of entomology at the Massachusetts Agricultural College, to fill the vacancy caused by the resignation last year of Dr. W. S. Regan, who was called to Montana. Dr. Alexander is a graduate of Cornell University and since graduation, he has taught at Cornell, the University of Kansas and the University of Illinois. For two years he had charge of the insect collections at the University of Kansas, and for the past three years has been connected with the Illinois State Natural History Survey, and has had charge of the insect collections. Dr. Alexander has specialized in systematic entomology, particularly in the dipterous family Tipulidae. He will assume his new duties next September.

Mr. Arthur Gibson, Dominion Entomologist of Canada, spent April 21 to 24 inclusive, in Washington, D. C. On April 23d he attended a meeting of representatives of biological societies called by the United States National Research Council. On April 24th, by invitation of Dr. Howard, he attended the first session of the

National Academy of Science at which Dr. Howard presented a paper relating to some recent work of the United States Bureau of Entomology in importing parasites of injurious insects. The balance of the time at Washington was spent in conference with various members of the Bureau. On April 25th, Mr. Gibson spent the day in the neighborhood of New York in company with Mr. Shaw who is in charge of the United States Federal Horticultural Board work at that port. The vacuum sterilizing plant at Brooklyn and the vacuum fumigation plant at Staten Island were visited. April 27th was spent with Dr. T. J. Headlee, State Entomologist of New Jersey. In the morning in company with Messrs. MacIntyre and Weiss, a visit was made to the gipsy moth infestation and in the afternoon certain phases of the New Jersey mosquito work were examined.

We learn from *Nature* that a prize of $5,000 is offered by Mr. Frank J. D. Barnjum of Montreal for a practical method of combating and suppressing the spruce bud worm, bark beetle and borer, which have caused such tremendous damage in the forests of Eastern Canada and the United States. The Province of Quebec alone has suffered a loss during the past ten years of 150,000,000 cords of standing pulpwood by these pests, which represents a market value in pulpwood of three billion dollars, or if manufactured into paper, of seven billion dollars. This represents a loss of wood sufficient for forty-five years' requirements for newsprint for the North American continent. The competition closed on August 1, and the $5,000 will be given for the successful suggestion that is accepted by the judges, who will be Sir William Price of Messrs. Price Bros., Quebec; Dr. C. D. Howe, dean of the faculty of forestry, Toronto University; Mr. Fred A. Gilbert, Great Northern Paper Company, Bangor, Maine; Mr. G. C. Piche, chief of forest service, Quebec, and Mr. Ellwood Wilson, Laurentide Company, Grand Mere, Quebec. Competitive suggestion, should reach Mr. Frank J. D. Barnjum, New Birks Building, Montreal, Canada. before August 1.

Announcement has been made of the following appointments in the Entomological Branch, Canadian Department of Agriculture. Mr. A. Kelsall, Assistant Entomologist, has been promoted to the rank of Entomologist to replace Mr. George Sanders who recently resigned from this post. He will be in charge of the Insecticide Investigations now being conducted at the Annapolis Royal laboratory. Messrs. H. H. Thomas and Norman Cutler have been appointed as Junior Entomologists and will assist Mr. Hopping in the pine bark beetle control work in British Columbia. Mr. A. W. MacKenzie and Mr. R. E. Balch have been appointed as Temporary Investigators of insect Pests. Mr. MacKenzie will assist Mr. Dunn in New Brunswick and Mr. Balch will be stationed for the present at the Aylmer, Que., forest insect station to assist Mr. Hutchings. Messrs. Dunn and Fleming are now in northern New Brunswick studying budworm injury to red spruce in that region. Mr. R. S. Hawkins has been attached to the Fredericton laboratory as Insect Pest Investigator and will assist Dr. Tothill in natural control studies of the tent caterpillars, etc. Mr. A. B. MacAndrews has also been attached to the same laboratory as Insect Pest Investigator and will assist Mr. A. B. Baird on natural control studies of the larch sawfly, larch case-bearer, etc. Messrs. A. Fowler, C. S. Thompson and W. L. Oliver, have been attached as Investigators of Insect Pests, to the Port Stanley laboratory in connection with Corn Borer Quarantine work. Temporary appointments for the summer: Mr. Walter Carter, Junior Entomologist, at Lethbridge, Alta; Mr. George Hammond, Insect Pest Investigator at Ottawa. He recently received his B.S.A. degree from McDonald College; Mr. A. A. Wood, Insect Pest

Investigator at Strathroy, Ont.; Mr. R. H. Painter, Junior Entomologist, at Port Stanley, Ont.; Mr. H. E. Gray, Junior Entomologist, at Lethbridge, Alta.; Mr. A. Robertson, Junior Entomologist, at Treesbank, Man.; Mr. R. M. White, Junior Entomologist, at Treesbank, Man. Mr. J. N. Knull, of the Pennsylvania Department of Agriculture, Harrisburg, Pa., has been appointed as a temporary Entomologist for the summer and will assist Dr. Craighead in the spruce budworm investigations. Mr. Knull reported for duty on May 29th and accompanied Dr. Craighead on his recent trip to Long Lake, Que. Mr. C. B. Garrett appointed temporarily as an Insect Pest Investigator is making collections, etc., in the Banff district. Mr. L. M. How, appointed temporarily as an Insect Pest Investigator, reported for duty on May 11th.

The American Association for the Advancement of Science, Pacific Division meeting at Salt Lake City was attended by quite a number of Entomologists. Saturday, June 24th, the Entomologists, Pathologists, Ecologists and members of the Society of Western Naturalists made an excursion up Parley's Canyon to study notable formations and the peculiar flora and fauna. About fifty persons made the trip. Among the persons attending this excursion were: Professor E. V. Gautier, of the University of Algiers; Dr J. P. Lotsy, of the University of Leyden; Professor F.B. Sumner, of Scripps Institute for Biological Research; Dr. David Starr Jordan, of Stanford University; Dr. Barton W. Evermann, California Academy of Sciences; Professor G. B. Rigg, University of Washington; Dr. W. L. Tower, American Hospital, Tampico, Mexico; E. P. Van Duzee and wife, California Academy of Sciences; Mr. R. E. Campbell and wife, Bureau of Entomology, Alhambra, California; A. O. Larsen, Bureau of Entomology, Alhambra, California; Professor Hazel Field, Mac Coun College, New Oleans, La.; A. R. C. Haas, Citrus Experiment Station Riverside, California; Professor G. W. Hungerford, University of Idaho; J. M. Reeder, University of Idaho; Dr. A. L. Lovett, Oregon Agricultural College; F. S. Baker, Forest Service, Ogden, Utah; H. S. Reed, Citrus Experiment Station, Riverside, California; Dr. I. M. Hawley, and Dr. B. L. Richards, Utah Agricultural College, Logan, Utah; Professor H. R. Hagan, and Professor Pansy Evans, University of Utah; Professor A. O. Garrett, Salt Lake City High Schools, George I. Reeves, Bureau of Entomology, Salt Lake City; G. G. Thorne, Bureau of Plant Industry, Salt Lake City; Dr. E. G. Titus, Utah-Idaho Sugar Company, Salt Lake City; and a number of others.

Horticultural Inspection Notes

Messrs. J. Leslie Rogers and Frank D. Luddington have been given temporary employment at the Connecticut Station in nursery inspection work.

The brown-tail moth work in Nova Scotia was completed on March 31, a total of 979 nests were collected during the winter as compared with 530 collected during the preceding year.

Inspectors of the Federal Horticultural Board on the Mexican Border have been kept busy intercepting, in co-operation with Customs officials, contraband plant material. To illustrate—during the fiscal year of 1921 and 1922, 19,773 avocados were intercepted.

Professor R. Kent Beattie of the Federal Horticultural Board attended the meeting of the American Association of Nurserymen in Detroit from June 28 to 30, and gave an address on "Protecting American Nurserymen Against Foreign Plant Pests."

Dr. C. L. Marlatt, Chairman, and Messrs. K. F. Kellermann and G. B. Sudworth, members, of the Federal Horticultural Board, attended the interesting conference on horticultural and plant quarantine matters held at Sacramento, Cal., from May 29 to June 3, 1922.

In Connecticut the State gipsy moth quarantine has been extended to coincide with the Federal quarantine which became effective July 1st. The State quarantine takes effect July 20, and is Quarantine Order No. 4.

Messrs. A. F. Burgess and D. M. Rogers of the Bureau of Entomology were present and explained the working of the Federal quarantine at a hearing in Hartford July 6, to extend the Connecticut State quarantine because of the gipsy moth.

To illustrate some of the disagreeable duties of an inspector performing his official work at a port of entry—the inspectors of the Florida State Plant Board were recently forced to have removed several wreaths which arrived from Havana on a casket. On dissecting the floral pieces, leaves were found infested with egg spirals and pupae of the black fly.

On June 12, a vessel containing 808 bags of cotton seed arrived in New York from Porto Rico for trans-shipment and immediate export to Scotland. This seed was unladen upon a lighter under the supervision of Inspector R. G. Cogswell who made a careful examination of some of the seed and found it to be infested with the larvae of the pink bollworm.

Mr. George Makinson reported for duty as inspector on the apple sucker quarantine on April 3d. Mr. Makinson will be stationed at Wolfville, Nova Scotia. Mr. Wilfred Ryan reported for duty on April 15th at Toronto. Mr. Ryan assisted in the inspection of nursery stock and will be transferred later to the corn borer work. Mr. Arthur Finnamore has been assisting in inspection work at Toronto since early in April. Mr. N. A. Patterson has been attached to the staff at Annapolis Royal in the capacity of Inspector of Insect Pests.

On April 21, 1922, the Destructive Insect and Pest Act Advisory Board of Canada was constituted by Order-in-Council. The present members are: Mr. Arthur Gibson, Dominion Entomologist, Chairman; Mr. E. S. Archibald, Director of the Experimental Farms, Vice-Chairman; Dr. J. H. Grisdale, Deputy Minister of Agriculture, Mr. H. T. Gussow, Dominion Botanist; and Mr. L. S. McLaine, Chief, Division of Foreign Pests Suppression, Secretary. The Board will supervise the carrying out of the regulations under the Destructive Insect and Pest Act, and will also recommend from time to time such changes or additions to the regulations as may be deemed necessary.

The work of the inspectors of the Federal Horticultural Board on the Mexican Border has been considerably reduced as a result of the heavy rains during the month of June. The movement of traffic between the ports of Del Rio, Eagle Pass, and Laredo, and the corresponding Mexican towns was discontinued for a few days. Both the railroad and foot bridges at Eagle Pass were carried away by the rain, and as a result, railroad traffic has been stopped at that port. The National Lines of Mexico were cut, and there will probably be no cars for examination in Matamoras for a month or more.

Pacific Slope Notes

Dr. E. P. Van Duzee, who has been collecting in Utah, visited the Agricultural College at Logan and took part in a trip to White Pine Lake.

Mr. George E. King, formerly Assistant Entomologist of the Utah Agricultural Experiment Station, has entered the University of Illinois. Mr. King will assist in apiculture and do graduate work.

Mr. Justus Stevens is acting as field assistant in Entomology at the Utah Agricultural College. Mr. Stevens will take the place of Mr. George E. King who has entered the University of Illinois.

Dr. James G. Needham of Cornell University gave a series of three lectures to summer school students of the Utah Agricultural College. Dr. Needham was the guest of Dr. I. M. Hawley, head of the Department of Zoology and Entomology of the Agricultural College. Collecting trips were taken to White Pine Lake, Logan Canyon, and Franklin, Idaho. On the last named trip a serious outbreak of the "Mormon cricket" (*Anabrus simplex*) was visited.

Prof. Ralph H. Smith, formerly entomologist of the Idaho Station and now with the California Central Creameries Co., with headquaters at San Francisco, Cal., has traveled for six weeks through the Eastern States, visiting most of the Agricultural Experiment Stations. He was at New Haven, Conn., on June 16th, and demonstrated the use of casein spreaders in spray mixtures.

A change in the personnel of the entomological staff of the University of Idaho and in the plan of organization has recently been made. With the resignation of Mr. Ralph H. Smith, Mr. Claude Wakeland has been appointed Experiment Station Entomologist and has been succeeded by Mr. Don B. Whelan as Extension Entomologist. Mr. Whelan received his graduate training at Kansas State Agricultural College and at Ohio State University. He was Extension Entomologist for Michigan for three years, resigning to accept a position with the Dow Chemical Co. After a year in commercial work he entered business on his own account in Michigan, but has returned to professional work because of the greater interest it holds for him. Under the reorganized plan of work, experimental and extension entomology will be conducted with very close co-operation, since both phases of work are under the supervision of the Station Entomologist. The outstanding extension problem for the season is spraying for control of alfalfa weevil, and the main experimental problems are control of eleodes beetles attacking grain crops and control of alfalfa weevil by dusting.

Apicultural Notes

The Connecticut Beekeepers Association held one of its summer field meetings, Saturday, June 24, at the home of Miss Caroline Baldwin, New Haven.

Mr. George E. King, formerly of the Agricultural Experiment Station, Logan, Utah, is now in charge of Apiculture at the University of Illinois, Urbana, Ill.

The Maryland State Beekeepers' Association held a meeting at the Bee-Culture Laboratory on June 29th. This Association has paid a visit to the Laboratory for the past several summers.

Mr. R. B. Willson, formerly extension specialist in beekeeping in Mississippi, has been transferred to Cornell University where he will continue the extension work carried on formerly by Mr. George H. Rea.

The annual beekeepers' Chautauqua held by the University of Wisconsin will be held at Green Bay, Wisconsin, the week beginning August 7th. E. F. Phillips, E. R. Root, George S. Demuth, S. B. Fracker, H. F. Wilson and C. P. Dadant are expected to attend and take part.

On August 21 and 22 there will be meetings in Tennessee arranged for the Southern itinerary of beekeepers. On the 21st the meeting will be held at Clinton, Tennessee, and the members of the East Tennessee Beekeepers' Association will be present. On the 22 the meeting will be held in the queen rearing yard of John M. Davis of Springhill, Tennessee, and the members of the Tennessee Beekeepers' Association will be present. The program for these meetings is being made out at this time. Honey production in the State is considerably below normal this year, due to the extended rainy season in the spring.

The following appointments have been made in the Bee-Culture Office of the Bureau of Entomology for the summer months: Mr. A. D. Shaftesbury to work on the aging of worker bees; Mr. Bruce Lineburg to work on the responses of worker bees to light; Mr. Bernard Kurrelmeyer to work on the transmission of lights of various colors through honeys, for the purpose of establishing color standards for extracted honeys; Mr. L. M. Bertholf to examine bees to determine whether the mite causing the Isle of Wight disease is present; Miss Effie Ross, Miss Margaret Swigart, Miss Winifred Hull and Mr. Paul Smith, temporary assistants. The first four named are graduate students at Johns Hopkins University.

Department Of Insecticides

It is planned to review in a brief way, from month to month, the progress in insect control, and especially to record the new insect controls and new insecticides. The object is to place this information in a concise form before entomologists as promptly as possible since it is becoming difficult for those interested in insect control problems to keep in constant touch with the newer discoveries. It is hoped that we may utimately standardize, as far as is practicable, the control measures and particularly formulas of standard insecticides. The need of such a standardization was recently called to our attention when we had occasion to examine many publications containing insecticide formulas.

Authors are requested to promptly send to the undersigned all papers giving information on new insect controls and insecticides.

The past year has been noteworthy for progress, or at least stimulation, in insecticide development. Probably no problem in control by insecticides has received as much unusual attention and interest as the dust insecticides, particularly the comparative value of dust and liquid treatments and the use of nicotine dust. As a result several companies have placed on the market from 3 or 4 to 29 or more dusting combinations. Following the interest in dust insecticides there has been a corresponding progress in dusting equipment, resulting in the development of several unique and useful machines. It is impossible at this early date to predict the outcome. There are indications that dusting may find ausefulness in the control of insects and diseases attacking orchard crops, but there is a larger outlook and a more promising field for dust treatments in the control of vegetable crop pests.

The creation of the Plant Protection Institute and the untiring labors of its present chairman have played an important part in the interest in insecticides now being shown. It is hoped that this organization may continue to point the way and call to the attention of entomologists the need of investigations along various lines and especially to correlate the work being done in the various parts of the United States. Summer sprays for the control of scale insects is much needed at the present time, and reports being received daily illustrate the little we know as to the cause of summer injury by lime-sulphur and certain other summer sprays.

Publications have recently shown an interest in the development of paraffine oil sprays, both for dormant use and for summer applications.

There is need for studies on the further use of such prominent "special-use" insecticides as sodium fluoride and bichloride of mercury. The almost universal use of paradichlorobenzene for the control of the peach tree borer is evidence of the great need of underground fumigants. The calcium arsenate-gypsum control for the striped cucumber beetle, discovered by Messrs. Houser and Balduf is an achievement of great value. It might be of interest to note that Mr. H. A. Cardinell of the Missouri Extension Department, reports (Proc. Amer. Soc. for Hort. Sci., 1921, pp. 123-130) experiments against the striped cucumber beetle and observes that a mixture of one pound of arsenate of lead, ½ pound of Paris green, and 15 pounds of hydrated or air-slaked lime proved to be more effective against the cucumber beetles, was easier to apply, and gave less injury from burning, than did the calcium arsenate-gypsum mixture. Another insecticide, suggested several years ago by Dr. Wm. Moore, (Jour. Econ. Ent., vol. 11, June 1918, p. 341) but which seems not to have been given sufficient consideration by entomologists is nicotine oleate. In Indiana this insecticide has been tested by Mr. H. F. Dietz, and the writer, and results to date indicate its usefulness, particularly for greenhouse crops.

The subject of spreaders and adhesives is one of considerable interest to all entomologists and the unusual developments along this line the past year are very promising.

May 22, 1922 J. J. Davis

Summer Meeting of the Entomologists of the Northeastern Part of the United States

On July 26 to 28 the Entomologists of the northeastern part of the United States held a meeting in the western fruit section of New York State. On Wednesday morning about 18 autos left Lockport, N.Y., and toured thru fruit sections of Niagara, Orleans, Monroe, Wayne and Ontario Counties. This tour occupied two days and the results seen on dusting and spraying were highly valuable from an entomological standpoint.

Wednesday evening an informal get-together was held at the Seneca Hotel, Rochester. At this meeting Dr. D. N. Borodin of Russia gave a brief resumé of entomology and conditions as they exist in Russia today. Dr. Headlee, the chairman, appointed a nomination committee and Mr. Burgess reported on the coming annual meeting to be held in Boston in December, 1922.

Thursday evening a splendid banquet was held at the Seneca Hotel in Geneva. Some sixty persons attended. The chairman, Dr. T. J. Headlee called on C. P. Lounsbury of South Africa, who gave an informal discussion on the early and present day development of entomology in South Africa.

After this splendid talk the question of dusting for the control of insect pests was presented. The discussion was opened by Dr. W. Rudolfs of New Brunswick, N. J., who gave us some valuable chemical data on contact insecticides. This talk was followed by Prof. P. J. Parrot, who gave us a review of his wide experience in the control of various pests with dusts. After considerable discussion, the question was brought to a close and Dr. E. D. Ball was called on for a few remarks. He presented some important views on the trend of entomology and brought out some of its needs. His comments on the success attained in raising the salary of scientific workers connected with the government bureaus was encouraging.

The chairman concluded the meeting by calling for a report from the nomination committee. The following officers were nominated and elected to act for the coming year: Prof. G. W. Herrick, Ithaca, N. Y., as chairman, and M. P. Zappe, New Haven, Conn., as secretary.

Friday morning a tour was made through the experimental plats on the grounds of the Geneva Agricultural Experiment Station. From there a run was made to Ithaca where we lunched together and then visited the department of Entomology at Cornell University. We were also entertained by Dr. and Mrs. J. H. Comstock in their home.

All told the annual summer meeting was a decided success. All of those fortunate enough to attend, wish to express their appreciation of the manner in which the meeting was conducted. Many favorable comments were made on the splendid entomological work that is being conducted by entomologists in the state of New York.

The following attended the meeting: C. P. Lounsbury and wife, South Africa; A. L.Quaintance, Washington, D. C.; D. C. Heim, Sunbury, Pa.; G. E. Sanders, Louisville Ky.; T. J. Headlee, New Brunswick, N. J.; R. S. Slate, Chaumont, N.Y.; L. T. Barnes, Elmira, N.Y.; F. D. Gorton, Rochester, N. Y.; S. W. McNall Rochester, N.Y.; G. H. Wakeman, Middleport, N. Y.; D. E. Fink, Riverton, N. J.; B. H. Walden, New Haven, Conn., M.P. Zappe, New Haven, Conn.; P. Garman, New Haven, Conn.; A. J. Farley, New Brunswick, N. J.; W. Rudolfs, New Brunswick,N.J.; A. Peterson, New Brunswick, N. J.; M. Tower, Middleport, N. Y.; F. J. Sutton, Middleport, N. Y.; W. P. Hays, Frankfort, Ind.; H. Doane, Rochester, N. Y.; P. J. Parrott, Geneva, N. Y.; E. N. Cory, College Park, Md.; E. P. Felt, Albany, N. Y.; W. J. Schoene, Blacksburg, Va.; C. R. Crosby, Ithaca, N. Y.; J. B. Palmer, Ithaca, N. Y.; S. R. Hearns, Ithaca, N. Y.; H. Glasgow, Geneva, N. Y.; A. L. Pierstorff, Rochester, N. Y.; H. W. Fitch, Ithaca, N. Y.; G. E. Smith, Albion, N. Y.; H. E. Thomas, Ithaca, N. Y.; C. F. W. Muesebeck, Melrose Hlds. Mass.; C. W. Collins, Melrose Hlds., Mass.; G. F. MacLeod, Geneva, N. Y.; J. R. Stear, Chambersburg, Pa.; L. F. Strickland, Lockport, N. Y.; S. W. Harmon, Geneva, N Y.; T. T. Haach, North East, Pa.; D. M. DeLong, and wife, Columbus, O.; D. F. Barnes, Melrose, Mass.; P. T. Barnes, Harrisburg, Pa.; T. L. Guyton, Harrisburg, Pa.; F. L. Holdridge, Lancaster, Pa.; F. J. Webb, Barker, N. Y.; A. F. Burgess, Melrose Hlds, Mass.; E. D. Ball, Washington, D. C.; D. N. Borodin, Russia, F. Z. Hartzell, Fredonia, N. Y.; H. E Hodgkiss, State College, Pa.; J. L. Horsfall, Philadelphia, Pa.; S. W. Frost, Arendtsville, Pa.; M. D. Leonard, New York City.; W. A. Ross, Vineland Station, Ontario.; B. A. Porter, Washington, D. C.; and G. W. Herrick, Ithaca, N. Y.

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ANT CONTROL ON SHIP BOARD

By W. T. CLARKE, *Professor Agricultural Extension, University of California*

Early in December, 1921, the Pacific Mail Steamship Company asked for help in the control of ants infesting certain of their passenger ships. This Company runs a line of vessels to and through the Panama Canal and thence northward to Havana, Cuba, and to Atlantic seaboard points in the United States. The ants were said to be very troublesome on the ships of this line. They not only caused a considerable pecuniary loss in the destruction of food stuffs but attacked passengers and crew. Their bite was reported to be very painful, causing a local swelling and inflammation with much itching. The situation as reported was worthy of careful study to develop control measures and the writer took up the study.

A careful search of the literature on ants failed to disclose any report of these creatures having been made on ship board and the problem developed, for this reason, into an entirely new study aided, to be sure, by the successful control measures used on shore. It was finally decided that to do the problem some degree of justice the study should extend through an entire voyage of one of the Company's ships. The ship chosen was the Colombia due to sail from San Francisco December 12, 1921, on its twenty-second voyage, outward destination being Baltimore, Maryland. Before the ship sailed a careful inspection was made and no ants found. As the weather was quite cold at the time, the presumption was made that the ants were dormant. Officers and members of the crew who had been on the Colombia on the previous voyage were unanimous in stating that the ants had been present in overwhelming

The Colombia remained at Baltimore four days and began the return trip on January 12, 1922, and left Norfolk, Virginia, on the 14th. Arsenical syrups, formulas A and B, were placed in all rooms on that day though no ants were seen. Indeed they did not appear till we left Havana, Cuba and were in the Caribbean Sea January 18th. The attack was light and easily controlled with the formula C powder. On the night of January 20th a vicious attack by the ants were reported in three rooms directly across from the engine room. These rooms were visited at midnight and it was found that the ants were attempting to establish formicarys in the beds. They were carrying pupae to these beds in great quantity. A liberal use of the powder quickly relieved the situation. The following day the cause of the migration was discovered. A boy had been sent up the ventilator shaft connecting with the engine room. The boy's visit was for purposes other than ant hunting but he got into a well populated formicary in the shaft. He came out in a hurry, literally covered with ants. He was severely bitten. This disturbance had undoubtedly made the ants uneasy, hence the attempt to establish new formicarys. Owing to the necessity of keeping these ventilators in active use while the engines were going, drastic treatment of them had to be put off till January 23d while the ship was lying at the dock at Cristobal, Canal Zone. Here we had the outside ends of the ventilators covered with canvas and then ran live steam into them for an hour. Vast numbers of ants were destroyed by this action. From January 24th on, only occasional small straggling groups of ants were seen and no complaints were registered. The last ants were seen as we left Manzanillo, Mexico, northbound on February 3, 1922. We here experienced cold weather conditions which continued until our arrival in San Francisco on February 10th. Careful inspection and search failed to disclose a single ant. They undoubtedly had again gone into dormancy and so ended the ship board ant campaign.

The frequently recurring dormant periods seem to stimulate these ants to very active work when warm conditions supervene. In the period that this study was made, fifty-eight days, the ants were dormant three times and the time devoted to reproduction and the gathering of stores was brief as compared with the same activities under normal conditions on shore. Certain it is that these ants were numerous, active and vicious.

In view of the seriousness of the pest on shipboard, the money loss due to their depredations on stores and the extreme discomfort their

presence gave passengers we recommended, first: A complete fumigation of the affected ships with sodium cyanide gas. Second: The equipment of the Chief Steward's office with a full supply of perforated tins, with sponges, and a quantity of the formula A and B syrup. Third: That formula C powder be furnished the same office in quantity. These last two recommendations were made so that the steward and his helpers might be in a position to combat ants did they appear in spite of the fumigation. These recommendations have been acted upon and the economic control of this pest on shipboard has been accomplished.

FORMULA A, GOVERNMENT FORMULA FOR ARGENTINE ANT POISON:

Granulated sugar	9 lbs.
Water	9 pts.
Tartaric acid (crystalized)	6 grams
Benzoate of soda	8.4 grams
Boil slowly for 30 minutes. Allow to cool.	
Dissolve sodium arsenite (C.P.)	15 grams
In hot water	½ pt.
Cool. Add poison solution to syrup and stir well. Add to the poisoned syrup:	
Honey	1¼ lbs.
Mix thoroughly.	

FORMULA B, FORMULA FOR NATIVE ANT POISON:

White Arsenic	2 oz.
Caustic soda	2 oz.
Sugar	1 lb.
Water	1 pt.

FORMULA C

6 parts by bulk—Sodium flouride
2 " " " —Pyrethrum (Buhach) powdered stems and flowers
2 " " " —Corn starch

Teaspoon, tablespoon, cup, indeed any convenient measure may be used in making up this powder. Care should be taken to maintain the above given porportions. This powder can be easily used in beds and where ants are by dusting from can with perforated top.

THE ATTRACTION OF *CHLORIDEA OBSOLETA* FABR. TO THE CORN PLANT[1]

By JAMES W. MCCOLLOCH, *Associate Entomologist, Kansas State Agricultural College and Experiment Station*

A complete study of the life economy of any insect must eventually include a consideration of the fundamental activities necessary for the

[1]Contribution No. 65 from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 9 of the Agricultural Experiment Station. The writer desires to express his appreciation for the assistance rendered by Mr. H Yuasa in the experimental work of 1919, and in securing certain literature not available in the Station Library.

perpetuation of the species. It is a recognized fact, as has been pointed out by Hewitt[2], Brues[3], and others that in most cases the female insect selects the larval food by depositing its eggs on substances best suited for the nourishment of the larvae and that this instinctive behavior or response to chemical stimuli has untold possibilities in the solution of many entomological problems. Brues attributes the selection of food plants to one or several factors, namely, (1) the odor and taste of the plant, (2) some attribute of the plant, perhaps an odor, but far less pronounced to our senses, (3) a similarity of the immediate environment or general form of the plant, and (4) apparent chance associations that have become fixed whereby diverse plants are utilized by oligophagus species.

In the study of the corn earworm (*Chloridea obsoleta* Fabr.) which has been in progress at this Station for several years, considerable attention has been given to oviposition, since the plants and parts of plants selected for egg deposition determine largely the feeding habits of the larvae. The corn earworm presents many difficulties in a study of its field activities because of its cosmopolitan distribution and wide range of food plants. It is generally conceded, however, that throughout its habitat it manifests a decided preference for the corn plant wherever present.

A review of the literature indicates that comparatively little study has been made of oviposition, and many workers leave the impression that the eggs are deposited indiscriminately on the plant. Quaintance and Brues[4], however, state that in the case of corn, the silks are usually chosen first if these are present on the plants. Egg counts which they made on silking plants indicate that approximately 40 percent of the eggs are deposited on the silks. These writers followed the oviposition on cotton and found a more promiscuous distribution of the eggs. A Total of 1141 eggs were found on cotton, 28.5 percent of which were deposited on the squares, and they state that it is quite possible that the large number of eggs laid on the squares is accidental and due to the attraction offered by them on account of the nectaries on which the moths feed. At any rate, the moths appear to oviposit indiscriminately wherever they happen to alight on the plant.

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[2]Hewitt, C. G., Insect Behavior as a factor in Applied Entomology. In Journ. Econ. Ent. 10:81-91, 1917.

[3]Brues, C T., The Selection of Food-Plants by Insects with Special Reference to Lepidopterous Larvae. In Amer. Nat. 54:313-332, 1920.

[4]Quaintance, A. L., and Brues, C. T., The Cotton Boll-worm. U. S. Dept. Agri., Bu. Ent. Bul. 50, 155 p., 1905.

In a previous paper, the writer[5] called attention to the fact that the moths show a decided preference for the silks of corn and, that when these are not available, the upper surface of the leaves and the stalk are selected. During the period 1913-1918, a total of 6867 eggs were found on 128 plants under daily observation from germination to maturity. Of these, 2100 or 30.6 percent were deposited on the silks. In order to discover whether the moths showed a preference for the plants while in silk, observations were begun in 1914 to determine the number of eggs deposited on the plants while in silk in comparison with the total number of eggs found. These data are presented in Table I, while Table II shows the location of the eggs deposited during the silking period.

TABLE I.—SHOWING THE NUMBER OF EGGS DEPOSITED WHILE THE PLANTS WERE IN SILK IN COMPARISON WITH THE TOTAL NUMBER OF EGGS—1914-1918.

Year	Total No. eggs	No. deposited while plants were in silk	% deposited while plants were in silk
1914	4646	2963	63.7
1915	330	260	78.7
1916	129	35	27.1
1917	92	84	91.3
1918	1091	459	42.1
	6288	3801	60.4

TABLE II—LOCATION OF EGGS DEPOSITED ON PLANTS WHILE IN SILK—1914-1918.

Year	No. of plants	Leaf Surface Upper	Leaf Surface Lower	Silk	Husk	Tassel	Stalk	Total	% of eggs on silks
1914	24	663	208	1546	89	164	293	2963	52.1
1915	24	46	3	161	5	7	38	260	61.9
1916	20	10	2	11	0	3	9	35	31.4
1917	20	8	1	56	5	0	4	84	66.6
1918	25	109	37	211	23	20	59	459	46.0
Total	113	836	251	1985	122	194	403	3801	52.2

From the data presented in the tables, it seemed apparent that the silks offered some attraction for the moths, since over 60 percent of the eggs were deposited during the period that the plants were in silk and 52 percent of these eggs were placed on the silks. In connection with these tables it is well to mention that 1916 and 1918 were very poor corn years, due to drought and hot winds. As a result, many of the plants did not produce silks and when they did appear they were soon destroyed by the extreme climatic conditions. It is also worthy of notice that under favorable conditions the silks are available for a short period in comparison with the other parts of the plant.

[5]McColloch, J. W., A Study of the Oviposition of the Corn Earworm with Relation to Certain Phases of the Life Economy and Measures of Control. In Journ. Econ. Ent., 13:242-255, 1920.

Observations on the behavior of the moths while ovipositing also indicate that they manifest at least a slight preference for the silks. More time is usually spent on the silks and it is not uncommon for the moth to deposit several eggs before leaving. The time spent on the other parts of the plant is usually very brief, and seldom more than one egg is deposited in a place. It might also be mentioned that the adults do not make use of the silks as a source of food, except possibly when the latter are saturated with moisture.

A study of these data suggested the possibility of a chemotropic response of the adult through the olfactory senses since the silk does possess a distinct odor. During the past three years certain preliminary experiments have been undertaken on the odor of corn silk as an attraction for the earworm moths. Imitation silks were made by taking 30 or 50 strands of cotton twine or yarn about 9-10 cm. in length and tying them together at one end. These were then impregnated with the odor of corn silk by soaking in juices obtained by crushing fresh silks every evening. In the following discussion these are spoken of as treated silks. Other sets were prepared identical with the above, except that they were not soaked in the juices and these are designated as checks. During 1919 and 1920 these imitation silks were placed in pairs on opposite sides of corn plants which bore no ears and were attached to the plants about 90 cm. above the ground. In 1921 they were placed on stakes set about in the corn field in order to eliminate any attractive effect which the corn plants might have on the results. Seventeen pairs of imitation silks were used during the three years and the results are presented in Table III.

TABLE III.—SHOWING THE NUMBER OF EGGS DEPOSITED ON THE IMITATION SILKS, 1919-1921.

Experiment No.	Period	No. of eggs Treated	Check	% on treated
1	Aug. 11—Sept. 9, 1919	20	3	86.9
2	" "	17	6	73.9
3	" "	11	4	73.3
4	" "	21	0	100.0
5*	" "	12	2	85.7
6	Aug. 27—Sept. 29, 1920	20	3	87.0
7	" "	15	4	79.0
8	Sept. 1 "	17	5	77.3
9*	" "	17	8	68.0
10	" "	32	2	94.1
11	" "	36	10	78.2
12	Sept. 4 "	42	26	61.7
13	" "	39	12	76.4
14*	Aug. 8—Sept. 19, 1921	24	4	85.7
15*	" "	22	4	84.6
16*	" 15 "	13	2	86.6
17*	" "	9	2	81.8
		367	97	79.1

*Placed on stakes removed from corn plants.

These experiments indicate that odor may be an important factor in attracting the moths to the corn plant, and that the subject is worthy of further investigation. A total of 464 eggs was deposited on the twines during the three years, and 79.1 percent were placed on the treated ones. The same results were obtained regardless of whether these twines were placed on corn plants or on stakes removed from the plants. Moths were observed on these "silks" at various times and when on treated ones they behaved very much as when on corn silks, often spending some time there and depositing several eggs. On the other hand, when they were on the check twines they appeared restless and often left without ovipositing. The treated twines retained the corn silk odor for several days.

The problem now resolves itself into a study of the composition of corn silk since the final interpretation of the results and the continuance of the experiment are dependent on this knowledge. A survey of the literature gives but little help on this point, since the constituents are but indefinitely known, although corn silk has long been recognized officially in the United States as a drug under the names "Zea," "Maidis stigmata" or "Corn silk." Insofar as the writer has been able to learn, practically all of the analytical work on the composition of corn silk has considered it as a drug.

Rademaker and Fischer[6] made an approximate analysis of the drug, corn silk, and a summary of the constituents which they found is given, together with the methods used in making the determination. (Table IV.)

TABLE IV.—SHOWING THE AMOUNT OF THE MOST IMPORTANT CONSTITUENTS OF THE DRUG, CORN SILK, AS FOUND BY RADEMAKER AND FISCHER

Constituent	Percent	Method used
Fixed oil	5.25	Petroleum spirit extract
Resin, Crystalline principle*, chlorophyll	2.25	Ether extract
Resin, Crystalline principle*, chlorophyll	3.25	Alchohol extract
Sugar, gum and extractive	19.50	Water extract
Albuminoids, phlobaphane, etc	3.50	From alkaline solution
Salts and extractive	5.50	From acid solution
Cellulose	37.00	
Water	20.00	

*This crystalline principle was found to be maizenic acid.

Hare, Caspari, and Rusby[7] state that "The only specific constituents of corn silk which are definitely known, and upon which its activity may depend, are its resin and maizenic acid. The latter is crystalline

[6]Rademaker, C. J., and Fischer, J. L., Proximate analysis of Stigmata maydis. In Amer. Journ. Phar, Vol. 58, Fourth series, Vol. 16, pp. 369-370. 1886.

[7]Hare, H. A., Casperi, C., and Rusby, H. H., The National Standard Dispensatory. Lea & Febiger, New York, 2081 p., 1916.

and soluble in both alcohol and water, as well as ether. Although the attempt to obtain volatile oil was unsuccessful, there is some volatile substance, since the drug has a distinct odor. Hillan, by treating it with an alkali and then distilling, obtained a very small amount of a substance which was basic and afforded alkaloidal reactions."

Schweitzer[8] gives the following analysis of fresh and dry corn silk (Table V), and points out that the fresh and dry silks differ in the loss of phosphoric acid by the former and increase of potash in the latter.

TABLE V.—ANALYSIS OF FRESH AND DRY CORN SILKS BY SCHWEITZER

	Fresh silk	Dry Silk
Grammes of dry matter	35.50	7.70
Grammes of fine ash	1.21	0.23
Percent of fine ash	3.39	3.00
Silica	8.23%	7.93%
Ferric oxide	1.05%	0.31%
Phosphoric pentoxide	19.11%	11.25%
Lime	4.32%	8.25%
Magnesia	7.71%	6.98%
Potassa	42.27%	19.66%
Soda	1.06%	2.66%
Total	83.75%	90.04%
Missing	16.25%	9.96%

None of these writers gives a definite clue to the source of the odor in the silk unless it be the reference of Hare et al in which they attribute it to a volatile oil. Thus far the writer has been unable to find anything in chemical literature treating of the crystalline principle, maizenic acid, other than that it is a compound present in the styles and stigmas of Zea mays.

While the odor of corn silk apparently plays an important part in the attraction of the earworm moths to the corn plant, the writer is aware that other factors must be considered. It has been mentioned that when the silks are not present, eggs are deposited on the upper surface of the leaves and on the stalks, and certain preliminary experiments conducted in 1921 indicate that these also produce an odor attractive to the moths. In addition, various morphological characters must be taken into consideration. It has been observed repeatedly in the experimental plots that plants with smooth leaves and stalks have very few eggs deposited on these parts in comparison with plants having rough hairy surfaces. It is also worthy of note that throughout the wide range of plants on which the earworm oviposits, there is an apparent selection of rough, hairy surfaces. Collins and Kempton[9] consider the prolongation of the husk beyond the ear, the thickness and texture of the husk

[8]Schweitzer, P., Study of the Life History of Corn at its Different Periods of Growths. Mo. Agri, Exp. Sta. Bul. 9, pp. 3-78, 1889.

[9]Collins, G. H., and Kempton, J. H., Breeding Sweet Corn Resistent to the Corn Earworm. In Journ. Agri. Research, 11:549-572, 1917.

and the presence of husk leaves as characters associated with the amount of injury due to the earworm.

The practical application of physiological and morphological studies offers certain possibilities worthy of further investigations. The writer is of the opinion that such studies, carried on in co-operation with the agronomist, the plant breeder and the chemist, open the way for certain intensive investigations which ultimately will prove valuable in the development of control measures. Many of the characters associated with earworm activities can be changed or modified by careful breeding, and varietal studies of corn may reveal certain strains lacking in some of the characters attractive to the moths.

THE RELATION OF HARD AND ALKALINE WATERS TO THE PREPARATION AND DILUTION OF SPRAYS AND DIPS

By E. R. de ONG, *University of California*

The insecticidal ingredients of sprays and dips have been studied sufficiently so their properties are now beginning to be understood, but the water used as a dilutant and carrier for them has received almost no attention from the entomologist or the insecticidal chemist. And yet the composition of the water varies widely according to locality, and from season to season, in the same vicinity. In the Santa Clara Valley, California, where this study was made, a range in variation of 2300 per cent was found, while the hardness in the tap water from one water supply company increased 11 per cent from the first of May until the middle of August. The latter change may have been due entirely to a seasonal variation or to a shifting of the source of supply. This instance will serve, however, to show that the analysis of water from a supply company may vary materially during the year. Complete yearly records have not been kept but we would naturally expect that concentration of salts in underground water supplies or surface streams would increase during a long continued arid season, such as is common in California.

The soluble salts in water are now recognized as a source of danger in two ways, in the preparation or dilution of sprays and dips:—(1) by chemical reactions with the insecticidal or fungicidal materials, which neutralize their efficiency or form dangerous compounds. For example, the use of alkaline or saline waters with acid (standard) arsenate of

lead may produce a soluble arsenical dangerous to foliage. (2) By physical reactions, such as the breaking of oil or cresol emulsions in hard waters, which free the chemicals held in suspension and destroy the value of the mixture. We now recognize such dangerous or neutralizing reactions when hard and perhaps alkaline waters are combined with petroleum or cresol emulsions acid lead arsenate, fish-oil or whale-oil soap and nicotine sulphate.[1] The formation of a precipitate in combining lime-sulfur solution with hard water has also been noted and further study of this subject may reveal other dangerous or undesirable combinations.

Water containing considerable quantities of sodium salts, including chlorids, bicarbonates and carbonates is classified as "alkaline." When considerable proportions of magnesium or calcium either in the bicarbonate or sulphate form are present the water is termed "hard." Water hardness is of two types, "temporary" and "permanent." The first is the result of bicarbonate of lime or magnesium held in solution by an excess of carbonic acid. This form is largely broken up by boiling, the carbonic acid being freed and the normal carbonates of lime and magnesium precipitated. Permanent hardness is the condition resulting from the presence of sulphates or chlorids of lime and magnesium and to the carbonates still held in solution after boiling. This form cannot be overcome by heating. Both types can, however, be partially counteracted by the addition of chemical water softeners.

In this paper no distinction is made between the various kinds of hardness, whether due to bicarbonate, sulphate or chlorid of calcium and magnesium, as their reaction with soap is somewhat similar. Neither will there be any distinction drawn between temporary and permanent hardness of water, the total hardness alone being estimated.[2]

Determination of Hardness

The soap consuming or destroying power of the water sample was

[1]Imes, Marian, "Cattle Lice and How to Eradicate Them," U. S. Farmers' Bul. 909 p. 14.

[2]A survey was made in 1919 of a typical horticultural region in California to determine the distribution and degree of hardness existing in the local waters. Samples of water were collected from the entire district, the degree of hardness determined by tests with a standard soap solution, and modified formulas for making oil emulsions worked out for each type of water. A map of the surveyed region was then made, giving the location of each well tested. Surveys of this nature, giving definite information about local water supplies, will enable the orchardist to choose spray materials suitable to his water supply. The manufacturer of insecticides will find this information of value in preparing and marketing his materials, and to the horticultural officer it will serve as a guide for his recommendations and will assist in interpreting orchard troubles.

measured by means of a standard soap solution, the same method of determination being used throughout so that the results would be comparable. The test is made by measuring out 50 cc. of the sample water into a stoppered bottle and adding measured quantities of the soap solution, with frequent agitations, until a lather is formed which remains permanent for two minutes. Many of the samples were so hard that to avoid using quantities of the standardized solution, only 10 cc. of the sample water was combined with 40 cc. of distilled water. The soap solution should be added in small quantities, shaking vigorously after each addition, until a permanent lather is secured over the entire surface of the water while the bottle is lying on its side. The number of cc. of soap solution thus used, multiplied by 50, (when 10 cc. of water were used) would give roughly the parts per million of calcium carbonate or equivalent salts. This process of calculation is not entirely accurate but since comparative results are wanted and not an exact analysis, it serves the purpose. If desired, a more accurate estimate of the degree of hardness can be obtained by checking the number of cc. of soap solution used with the tables found in a standard text book on water analyses.[3] In Table 1 is given a summary of the water analyses made, the column at the left indicates the degree of hardness. The column of percentages, at the right, indicates the proportion in which this degree of hardness was present in the total of all analyses made.

TABLE I.—SUMMARY OF WATER ANALYSES

Soap solution used	Proportionate amounts
cc.	%
4-5	1.04
5-6	11.96
6-7	33.12
7-8	36.27
8-9	13.42
9-10	2.30
10-plus	1.89
	100.00

Considering the index number, 6 and below as indicating soft waters, this would mean that only 13 per cent of the total can be placed in this class. If those of moderate degree of hardness, viz. 6-7, are included, the total still falls below 50 per cent, leaving a remainder of 53.88 per cent of the waters classified as decidedly hard. The orchardists of this region find the hardness of the waters a real problem. A few haul soft water from nearby locations, the majority attempt

[3] "Standard Methods for Examination of Water and Sewage,"—published by American Public Health Association, 2d edition (1912) p. 33.

to soften the water with chemicals. In recent years insecticides compatible with hard water are coming into more general use which, with the growing use of dusts, may be the solution of the problem.

Water Softening

The removal of temporary hardness from water by boiling is too expensive to be applied in spray practice, hence we must depend on chemical water softeners. The function of such chemicals in making oil emulsions is:—(1) to react with the salts in the water and thus reduce the soap consuming power; (2) to aid in emulsifying the oil; and (3) to prevent the formation of insoluble calcium and magnesium soaps, these having a tendency to clog the spray nozzle.

The chemicals commonly used for this purpose are caustic soda (NaOH), Soda Ash (a crude product), Sal Soda ($Na_2CO_3 \cdot 10\ H_2O$), Lye (a mixture of caustic and carbonate of soda), commercial water softeners (caustics, carbonates and phosphates), and ammonia.

Caustic soda was found to be superior, in the locality where the survey was made, to any other form tested. This was especially true in very hard waters. The value of caustic soda in softening hard water is shown in Table II.

Table II.—The Value of Caustic Soda as a Water Softener
(Amounts based on 100 gallons of spray mixture)

Caustic Soda		Reduction of Soap Consumption		Difference	
Amount	Cost	Amount	Cost	Gain	Loss
Lbs.	$	%	$	$	$
1.6	0.25	40	.51	0.26	....
3.2	0.51	54	.69	0.18	....
6.4	1.02	59	.75	....	0.27

1. The amounts in this table were computed on the basis of eight pounds of soap per 100 gallons. Soap and soda valued at 16c a pound.

2. The results from the use of caustic soda cannot be estimated alone by the reduction in soap consumption. Its value as an aid in emulsifying oil must be considered although it is difficult to estimate.

Oil Emulsions and Hard Water

Petroleum oil is usually emulsified with the aid of fish-oil or laundry soap. It is a well known fact that the use of hard water in the household and laundry hinders the formation of lather. Similarly, hard water destroys oil emulsions. In both instances, the soluble soda and potash soaps, which are unaffected chemically by soft waters, react with the calcium and magnesium salts in the hard water and form an insoluble soap. This insoluble soap is of no value in making

emulsions or to increase the cleansing power of the laundry water and hence is a waste. Therefore, if a hard water is used in preparing or diluting an emulsion, the hardness must be removed by the use of a preliminary softening agent or by sufficient soap to produce the same result. A slight amount of alkali in the water does not materially retard the action of soap but if excessive quantities of sodium salts are present, the formation of lather is checked.

TABLE III.—SUMMARY OF MODIFIED FORMULAS FOR MAKING OIL EMULSIONS WITH WATERS OF VARYING DEGREES OF HARDNESS
(Amounts based on 100 gallons of spray mixture)

Crude Oil					Distillate Oil				
	Caustic Soda		Soda Ash			Caustic Soda		Soda Ash	
Soap solution used	Amt. of caustic soda	Amt. of soap	Amt. of soda ash	Amt. of soap	Soap solution used	Amt. of caustic soda	Amt. of soap	Amt. of soda	Amt. of soap
C. C.	pounds	pounds	pounds	pounds		pounds	pounds	pounds	pounds
4–4.9	0.5	2.47	—	—	5–5.9	0.75	5.5	3	5.5
5–5.9	0.66	4.83	1.5	6	6–6.9	0.5	5	2	5
6–6.9	0.50	6.33	2.0	5	9–9.9	1.5	5		
7–7.9	0.8	6.83	2.2	7.8					
8–8.9	1.	7.0							
9–9.9	1.	7.0							

The amounts of water softener and soap given are averages of trials which have produced satisfactory emulsions in a number of waters with the degrees of hardness given in columns 1 and 6. These figures indicate the amounts of soap and softener required for making emulsions with water of a similar type, or the softener alone, if prepared emulsions are used which are not adapted to hard water.

Some variation from the amounts of softener and soap given will, of course, be necessary for different types of water and oil. The data given are simply the results from experiments where satisfactory emulsions were secured and hence may be taken as a basis from which to work. It should be remembered, however, that changes in the type of oil, water or softener used means a new experiment, and should be considered as such

THE RELATION BETWEEN ARSENICAL INJURY AND ALKALINE AND HARD WATERS

It has been shown by Headden[4] and Hayward & McDonnell[5] that the soluble salts commonly occurring in waters, (notably sodium chlorid, carbonate and sulphate) if present in more than small quantities, may exert a solvent action on lead arsenate. Headden states[3], "that he considers it unsafe to use alkali water as a carrier for lead arsenate,"

[4] Headden, Wm. P., "Arsenical Poisoning of Fruit Trees." Colo. Bul. 131, p. 220.
[5] Hayward & McDonnell, "Lead Arsenate," U. S. Bu. Chem. Bnl. 131, pp. 46-49.

and cites experimental data where sodium sulphate and particularly sodium chlorid had acted as a solvent for lead arsenate.

Hayward & McDonnell reported experimental data showing "that lead arsenate applied in water containing twenty parts of chlorin per million had caused more injury to peach foliage than when applied with distilled water, and that the addition of 10 to 40 grams of sodium chlorid or sodium carbonate per gallon had caused a heavy increase in arsenical injury." The usual reaction between acid lead arsenate and chlorin is the formation of a soluble arsenate and a complex lead salt. The sodium arsenate goes into solution readily in atmospheric moisture, and is then absorbed by the plant and causes burning.

To determine what salts are present and their proportions in waters with varying degrees of hardness, the following analyses were made of typical water samples.

TABLE IV.—ANALYSES OF SOFT AND HARD WATERS

Constituent	Parts per million		
	(1)[1] Very soft	(2) moderately hard	(3) very hard
Calcium (Ca)	40	50	25
Magnesium (Mj)	5	20	100
Sodium (Na)	32	52	384
Bicarbonate (HCO_3)	183	256	646
Sulphate (SO4)	10	50	150
Chlorin (C1)	10	40	440

HYPOTHETICAL COMBINATIONS OF ABOVE ANALYSES

Sodium Sulphate (NaSO4)	15	74	221
" chlorid (Na C1)	33	66	726
" bicarbonate (NaHCO3)	51	17	109
Calcium bicarbonate (Ca(HCO_3)2)	160	200	100
Magnesium bicarbonate (Mg (HCO_3)2)	30	120	600

[1]The amount of soap solution used in neutralizing the hardness of the three samples is, — (1) 4. 9, (2) 6. 7, (6) 14. 0.

It will be noted that the chlorin content of only the first one is less than twenty parts per million—the factor which was associated with arsenical injury in Hayward & McDonnell's experiments.

All hard waters do not necessarily contain chlorin, but they may have excessive quantities, as already mentioned, one of the common forms in which chlorin occurs is sodium chlorid, which is a characteristic component of saline rather than that of hard waters. A study of eighty analyses of California waters showed that only 14.8% of the total were apparently safe for use with acid arsenate of lead, when applied to tender foliage. These samples cannot be considered as typical because there is usually some suspicion regarding a water be-

fore an analysis is asked for. They do show, however, a large proportion of water unsafe for use with this common type of arsenical. When it becomes necessary to use alkaline or hard waters in spray work, the safest plan is to substitute basic arsenate of lead for the acid type. Milk of lime combined with acid arsenate of lead tends to prevent danger of this kind.

Conclusions: Hard and alkaline waters form dangerous combinations with many forms of insecticides.

Softening of hard water with chemicals is only partially successful. Water softening plants, with a capacity sufficient for supplying a spray outfit and for domestic purposes also, may be installed at a cost of a few hundred dollars.

The use of dusting materials, where practical, in place of liquid sprays is desirable, in that the user is inependent of the type of water found locally.

Insecticides compatible with the salts commonly found in waters are desirable and in many instances will prove a satisfactory solution of the subject. Examples of such substitutions are, basic arsenate of lead instead of the acid (standard) type, arsenical dips in lieu of cresol preparations, and the stable oil emulsions which are made for use in waters.

RELATION OF MOISTURE TO INGESTION OF POISON BY THE COTTON-BOLL WEEVIL

By D. C. Warren, *Georgia State Board of Entomology*

Considerable attention has recently been given to the problem of poisoning the cotton boll weevil by the use of calcium arsenate. The dusting method has been used and has given profitable results.

In Bulletin 731, United States Department of Agriculture, B. R. Coad concludes that "success in poisoning was due to ingestion by the weevil while drinking." He found that "only a very light mortality would result from tests where the plants were kept absolutely dry after poisoning; but as soon as moisture was introduced the mortality increased greatly."

During the summer of 1919 Wilmon Newell and Eli K. Bynum of the Florida State Plant Board carried out a series of experiments testing out the relation of dew or rain to the effective use of arsenates for poisoning the boll weevil.[1] Newell and Bynum carried out field cage

[1]Journal of Economic Entomology, February 1920.

experiments in which some of the cages were covered so as to prevent the formation of dew on the plants and in other cages the dew was allowed to form on the plants. In each case the plants were dusted in the same manner with calcium or lead arsenate. A slightly higher mortality was obtained in cages where the dew was not allowed to form.

Circular 38 of The Alabama Polytechnic Institute by W. E. Hinds gives briefly the results of tests conducted by the writer under the direction of Dr. Hinds during the summer of 1918. These were laboratory and field tests in which moisture was applied or allowed to form on the plants in one case and excluded in another. Here a slightly higher mortality was obtained on poisoned plants where the moisture was excluded and exclusion of moisture from the checks had no effect upon the mortality.

In view of the difference of opinion upon the question of whether moisture is essential for the weevil to ingest the poison, the writer considered it worth while to conduct further experiments upon the problem. Accurate information upon this question is essential in applying control measures for this insect.

Location of Experiments and Materials Used

The experiments here given were conducted at Valdosta, Georgia at the Sea Island Experiment Station of the Georgia State Board of Entomology during the summers of 1920 and 1921. The cages used were 3x3x4 feet and 4x4x6 feet. Vigorously fruiting plants were selected for caging and the bottom of the cages was covered with heavy paper so as to make the dead weevils readily seen. The calcium arsenate used was of the chemical constitution recommended for cotton dusting. A fairly heavy dosage of poison (about 10 pounds per acre) was applied to the caged plants.

Experiments Comparing Mortality from Feeding during the Period of the Day in which there is Dew on the Plant with the Period during which the Plant is free from Dew

These experiments were carried out in a manner somewhat different from those previously conducted in testing the relation of moisture to ingestion of the poison by the weevil. Here, mortality, from feeding during the period in which the dew remains on the plant, was compared with mortality from feeding during the period in which there is no dew on the plant. Thus the mortality among weevils which fed upon poisoned plants from 6 P. M. to 8 A. M. was compared with the mortality among weevils which fed upon poisoned plants from 8 A. M. to 6 P. M. The

weevils feeding in the presence of dew were removed in the morning (after feeding during the night) to fresh unpoisoned plants and those feeding in the absence of dew were removed (after feeding during the day) to fresh unpoisoned plants and mortality records were kept. In each case for comparison, check cages were run on unpoisoned plants. This should give an accurate and critical test of the role of dew in poison ingestion by the weevil. The only inaccuracy which enters in is the fact that those weevils feeding in the absence of dew have only a feeding period of 10 hours against 14 hours for those feeding in the presence of dew but it will be seen that this did not affect the results. It may not seem fair to compare night feeding with day feeding but if we assume that dew is necessary for the ingestion of the poison, this is the period in which the weevil has an opportunity to drink the dew. In each case the weevils were placed on the caged plant a few hours before applying the poison in order to allow them to adjust themselves to the plant. Cages of the size 3x3x4 feet were used in these experiments. The results of these experiments are given in table I.

TABLE I.

	Total No. weevils used	Mortality first 24 hours	Second 24 hrs.	Third 24 hrs.	Total mortality	Mortality Percent.
Day feeding	294	38	53	41	132	45
Night feeding	320	38	47	28	113	35
Check	301	16	34	25	75	25

A record was kept of the mortality for 72 hours after the poison had been applied, the first 10 or 14 hours of which were spent on the poisoned plant by the weevil. It will be seen from the table that there was a greater mortality (45%) among the weevils which fed during the period in which there was no dew on the plant although they remained on the poisoned plant a much shorter period than did the weevils feeding in the presence of dew (mortality 35%). The results given in table I were for the season 1920 and to further check the results the experiment was repeated in 1921 under more carefully controlled conditions.

It was found during the summer of 1920 that there was considerable difference in natural mortality among collections of weevils made in different fields or at different periods in the same field. It is probable at the late season when these experiments were conducted, there was considerable overlapping of broods so that, from one collection one might obtain only newly emerged weevils in which the natural mortality would be low, while from a nearby field one might obtain comparatively

old weevils in which there would be a high rate of mortality. So in the 1921 experiments care was taken to run the experiments in series so that the weevils from a single collection were equally distributed among the day feeding, night feeding and check cages. Also instead of removing the weevils, after their feeding period on the poisoned plant, to caged unpoisoned plants, they were placed in the insectary in gause-covered lantern globes with fresh cotton squares as food. In this way the difficulty from ants carrying away the dead weevils was avoided. The results of the 1921 experiments are given in table II.

TABLE II*

Test no.	Day feeding			Night feeding			Check		
	No. weevils used	No. killed	Percent killed	No. weevils used	No. killed	Percent killed	No. weevils used	No. killed	Percent killed
1	51	48	94	37	27	73	42	12	29
2	85	75	88	86	57	66	102	27	26
3	120	99	82	112	103	92	142	79	56
4	93	83	89				108	14	13
5	80	51	64	96	49	51	44	10	23
6	92	90	98				100	35	35
Total	521	446	85	331	236	71	528	177	34

*The blank spaces in the table are due to rainfall ruining this portion of the series of experiments.

Here the mortality was recorded for a period of 96 hours after the poison had been applied to the plant upon which the weevils were feeding. Here the mortality during the 96 hours following the application of the poison in the case of the weevils feeding in the absence of dew was 85 percent and for the weevils feeding in the presence of dew was 71 percent. Here again the death rate was higher among the weevils remaining on the poisoned plant the shorter period and during the period when they could obtain no moisture.

It is also of interest to note in this connection that a rather high percent of mortality was obtained from a very short feeding period.

Cage Test Comparing Conditions where Dew was Excluded with Conditions of Normal Dew Formation

These tests are the same type as were carried out by Newell and Bynum. The writer made a few of these tests to check up his own results obtained from attacking the problem from another point of view. Cages size 4x4x6 feet were used in these tests. The experiments were run in the following series: one cage was poisoned and covered, one was poisoned and left uncovered, one was unpoisoned and covered, and one was unpoisoned and left uncovered. Canvas covers were used for the cages and they were covered only during the period of dew formation

(about 7 P. M. to 7 A. M.) Experiments with which rain interfered are not recorded. Table III gives the results of the experiments.

TABLE III

	Total No. weevils used	Mortality first 24 hours	Second 24 hrs.	Third 24 hrs.	Total mortality	Mortality percent
Covered poisoned	200	10	46	56	112	56
Uncovered poisoned	200	10	32	62	104	52
Covered check	200	3	5	9	17	9
Uncovered check	200	2	10	7	19	10

It will be seen from table III that the exclusion of dew from the poisoned plant had no effect upon the rate of mortality. The percent killed during the period recorded is so near alike in the two, that the difference is probably due to chance variation. Also by comparing the covered and uncovered checks it will be seen that covering had no effect over the mortality.

Conclusions

So considering the results discussed here and those obtained by other investigators, it seems that it has been conclusively shown that the cotton-boll weevil is poisoned by ingestion of poison with its food rather than by drinking the poisoned dew. This conclusion has nothing to do with the time of day when the poison should be applied, for it is a well established fact that better results can be obtained from applying poison while the plant is wet with dew.

OBSERVATIONS ON INSECTS ATTACKING SORGHUMS

By Wm. P. Hayes, *Assistant Entomolgist*
Kansas Agricultural Experiment Station[1]

The following observations were made during the past few years in connection with a study at this station of insects attacking sorghums. The sorghum crop in Kansas is on the whole remarkably free from insect pests, escaping almost entirely the ravages of the sorghum midge and stalk-borers common in southern regions. In the selection of forage crops in western Kansas, consideration must be given to possible injury by grasshoppers and chinch bugs. Sudan grass and milo are much

[1]Contribution from the Entomological Laboratory, Kansas State Agricultural College, No. 71. This paper embodies the results of some of the investigations undertaken by the writer in the prosecution of project No. 92 of the Kansas Agricultural Experiment Station.

relished by grasshoppers, while kafir, feterita, and sweet sorghums are only eaten by them when other food plants are scarce. Chinch bugs attack milo and Sudan grass, concerning which more will be said later, and other sorghums to a lesser degree. It is obvious that with 2,353,324 acres of sorghums in the state, valued at $48,507,013.00,[2] any pest seriously attacking the crop could cause considerable damage.

Insects Attacking the Head

Sorghum Webworm.—The most serious insect attacking the 1921 crop was the sorghum webworm heretofore unreported as an enemy of sorghums in Kansas. Reports and specimens received from the southern part of the state showed that a lepidopterous larva was attacking the heads of kafir in damaging numbers. Specimens sent to Washington were determined as *Celama (Nola) sorghiella* Riley.[3]

The first report of damage was received Sept. 24, from Bourbon County, in which the county agent reported the larva eating the grain from kafir heads but not injuring the leaves or stalk. At the time of writing they had destroyed 13 acres. A second complaint from a Bourbon County farmer reported injury to cane as well as kafir, and stated that a heavy rain had apparently destroyed many of the worms.

In Chautauqua County, as high as 40 percent of the crop was damaged in some fields and the county agent in Cherokee County reported 100 percent injury. A survey of the vicinity of Manhattan, Riley County, revealed only one larva found on a kafir head and no reports were received from points in other than southeastern Kansas. Farmers in the infested area say that the appearance of this insect is more or less periodical, causing injury and then not being heard of again for several years.

In Cherokee County, an experimental field operated in cooperation with the Department of Agronomy contained the following varieties: Standard Blackhull Kafir, Pink Kafir, Sunrise Kafir, Feterita, Kansas Orange Cane, and Sumac Sorghum, all of which were attacked by the webworm.

Forbes (1905, p. 169) mentions that Ashmead found the species on tassels of corn. In 1908, the Yearbook of the U. S. Department of Agriculture (p. 570) states that this species breeds in heads of sorghum from Virginia to San Antonio, Texas.

Little is known of the habits of this species. Riley (1882, p. 187) first described the species from specimens received from Alabama where

[2]Figures from 22d biennial report of the Kansas State Board of Agriculture 1920.

[3]Determined by Mr. Carl Heinrich through the courtesy of Dr. L. O. Howard.

they were injuring sorghums. He likewise described the larval and pupal stages. The nature of the damage done in Kansas is similar to that described by Riley which is here quoted.

"The sorghum heads sent were, for the most part, so interwoven with silk as to form a compact mass, in which was profusely mixed the whitish excrement of the larva. Running through the mass were numerous delicate tubes, forming channels, through which the larvae passed from one seed to another unexposed to the attacks of parasites. The kernels of the grain were sometimes entirely eaten, but in general were only partly destroyed, the germ, however, seeming to be the portion of the seed preferred, as in almost every instance it was eaten. The larvae were very active when disturbed, and left the heads when ready to transform, spinning small silken cocoons upon the surface of the ground or in some sheltered place. The cocoons were about 7 mm. (a little more than a quarter of an inch) in length, somewhat thickest at the anterior end, and with a small opening at the posterior end, through which the last larval skin was partially pushed. They were made out of delicate, closely spun white silk, firmly fastened to the object selected by the larva for attachment, and were covered with particles of wood, bark, or excrement, so that they were readily recognized. The moths issued in late July or early August, a week or more after spinning of the cocoons."

At the time of writing—Dec. 18, 1921—the specimens are in the larval stage and it is possible that the species hibernates in this stage in Kansas. There is a slight possibility of two or more broods in Kansas and that some undetermined food plant offers sustenance to the species until the sorghum heads appear in the fields. The Yearbook of the U. S. Department of Agriculture for 1906 (p. 510) reports the species attacking the heads of timothy at Arlington, Va.

It was stated by southern Kansas farmers that the larvae "make sores or a kind of breaking out on the skin wherever they happen to crawl on a person." This rash produced a more or less severe itching and several farmers were reported unable to harvest sorghum crops because of poisoning received by coming in contact with the worm when attempting to harvest their crop.

Corn Leaf Aphis.—McColloch (1921. p. 91) reported injury to the 1919 crop of sorghums in Kansas by *Aphis maidis* Fitch. Certain fields in the western part of the state were ruined by the species which had caused, in the heavily infested heads, badly shriveled grain. The question arose as to the effect of this injury on the germinative powers

of the grain. Accordingly, a series of standard Blackhull kafir tests were planted, using uninjured grain as controls with 100 seeds in each test. These results are found in Table I.

TABLE I.—PERCENTAGE OF GERMINATION OF SEEDS INJURED BY APHIS MAIDIS.

Test number	*Percent of Germination* Uninjured grains	Injured grains
1	78	51
2	65	50
3	75	75
4	32	22
5	47	37
6	28	14
7	17	19
8	12	3
9	9	10
10	9	42
11	22	16
12	20	28
Average	34.50	30.58

Several thousand germination tests made by the writer in connection with studies of the insects attacking the seed of sorghums have shown the percentage of germination to be very low in check plots. The results of Table I show wide discrepencies, but an average of 12 plots shows a reduction of nearly four percent in vitality of the seeds. Such a reduction in seeds with naturally low vitality must be considered important.

CORN EARWORM.—Sorghum plants are generally regarded as incidental food plants of *Chloridea obsoleta* Fab. and little is found in the literature concerning it. Mally (1893, p. 18) found volunteer sorghum plants riddled by insects. He attributed some of this injury to the corn earworm, but thought most of it was due to cutworms. Quaintance and Brues (1905, p. 17) mention the corn earworm eating the tender central bud and green seeds of sorghums. Aside from such scanty references, no large amount of injury to sorghums has been charged to this species.

During the past summer (1921) the earworm was unusually abundant on sorghum plants, feeding at first on the leaves and curl and later on the green heads. No variety of sorghum was noted to have escaped the attack of the worms. In 1911 the earworm appeared in injurious numbers on kafir plants at Herington, Kansas, at which time as high as 8 to 10 worms could be found feeding on the green heads, and many moths were noted flying around the plants at night.

COREIDAE—As a minor pest attacking the head before maturity, *Leptoglossus zonatus* Dall. may be mentioned. It was noted sucking the sap of a green kafir head. Forbes (1905, p. 197) reports injury to

sorghum by another species of the same genus, *Leptoglossus phyllopus* Linn.

ANGOUMOIS GRAIN MOTH.—The granary pest, *Sitotroga cerealella* Oliv. was unusually abundant in sorghum fields during the 1921 growing season, causing considerable damage to all varieties of sorghums, and much loss can be expected in the stored crop. Injury to sorghums in the field is quite similar to that of other grains.

INSECTS ATTACKING THE STALKS AND LEAVES

CHINCH BUGS.—Sudan grass is relished by chinch bugs (*Blissus leucopterus Say*) and many bugs seek their winter quarters at the crown of the plants. An effort was made during the winter of 1920-1921 to ascertain whether Sudan grass offered favorable protection for the bugs. Accordingly, counts were made during the fall and winter in clumps of Sudan grass in which the stalks had been cut and in clumps with stalks left standing. No noticeable difference was observed between the cut and uncut as a means of protection. Owing to the mild winter and comparative scarcity of bugs, counts did not show large numbers in the clumps. During October, as high as 19 bugs were noted in individual clumps; in November, as many as 27, and 17 in February. Chinch bugs were more numerous the past summer (1921), and counts in November showed as many as 74 bugs to a clump.

Observations were made on the susceptibility of milo to chinch bug injury. To some it is a matter of common observation that young milo plants are more seriously injured by chinch bugs than any of the sorghums. Counts were made on the Kansas Experiment Station 1921 crop of sorghums. In the variety tests, out of 24 varieties, only three—Dwarf Yellow Milo, White Milo, and Progressive Kafir—showed dwarfed, stunted plants caused by bug injury, although many of the other varieties showed some injury to the lower leaves.

In these plots, Dwarf Yellow Milo exhibited the most injury, followed by White Milo and Progressive Kafir in the order named. In the breeding plots, White Milo showed as high as 25 per cent (by count) of injury per row, while Dwarf Yellow Milo showed only 20 per cent. Two interesting points were noted in this plot. Milo crosses in rows adjoining the injured milo plants were untouched by the bugs and showed luxuriant growth, attributed by plant breeders to what is known as 'hybrid vigor.' Some plants of volunteer corn growing between the rows of injured milo had but few bugs on them, and showed no damage, indicating that the bugs in this case preferred the milo to corn.

GREEN BUGS.—The green bug (*Toxoptera graminum* Rond.) occasionally injures Sudan grass as well as all other varieties of sorghum. In 1916, in western Kansas, this species did considerable damage, causing infested plants to turn yellow and die. Further injury by the bugs was checked by a dashing rain.

INSECTS ATTACKING THE PLANTED SEED

KAFIR ANT.—One of the most injurious pests of kafir is the tiny-thief-ant (*Solenopsis molesta* Say). The habits of this species have been rather fully discussed by the writer (1920). Mention was made at the time that no mating flight had been noted in Kansas, although citations were made of its occurrence elsewhere. Since then the following observations were noted, which may be of interest in connection with the mating habits of the species.

"A general mating flight of *S. molesta* occurred at 5:00 P. M., July 27, 1920, and until dusk the air contained thousands of individuals. Females were the more abundant. Mating occurred in the air. Mating pairs were seen to alight on the ground where the male would release himself at once and immediately take to flight again, evidently pursuing another female. Sometimes the female would fly and at other times would at once begin to shed her wings. This was done by kicking them off on one side with the rear leg of that side. The front wing came off first, then the other. Then turning onto the side of the body that had lost the wings, it would kick off the other wings in the same manner. This occupied only about one minute. Other females were seen to alight without males, and at once shed their wings. These were perhaps those individuals that had mated and taken to the air again. One such was seen to alight on the leaf of a sorghum plant and shed its wings on the leaf and then start to crawl down to the ground. The wingless queens crawled over the ground and sought cracks in the soil in which to enter. The night of July 25-26, 3.19 inch rain fell and the soil was very damp. A jelly glass in the laboratory containing "sex-larvae" collected June 24, 1920, had transformed and 12 males were observed running about actively on the surface of the soil in the jelly-glass cage. During the flight, one queen was observed near the crater opening of a *Lasius* colony. It was attacked by the *Lasius* workers and carried helpless into the opening of the *Lasius* nest. July 28, 1920, 9:30 A. M., all of the queens flying last night have sought shelter under corn leaves, stalks and clods in the corn and kafir plots. Three winged males were found walking on the surface of the soil. One male was seen with his

wings caught on the moist surface of the sorghum leaf. Several wingless queens were found under leaves, stalks, etc. Discarded wings were abundant on the surface of the soil. A spider was found carrying a dead, wingless queen on the surface of the sorghum plots. Aug. 5, 1920. A colony was found at the college farm in a corn field which contained a number of winged males, showing that not all participated in the flight of July 27."

During the flight, twelve of the newly mated queens were collected and placed in soil in jelly glasses. By Aug. 19, some of the queens had as high as 12 half grown larvae in a small chamber hollowed out in the soil, and on Sept. 25 a few workers were noted in several of the colonies. Nine of these queens successfully passed the winter in a cave and began to build up their colonies the next spring and summer. Seven colonies surviving are now passing their second winter in the cave. A second flight was observed by Mr. J. W. McColloch on July 5, 1921. This flight was 22 days earlier than the 1920 one, and as in the case of that flight, was preceded by a heavy rain.

THE SEED CORN MAGGOT.—The seed corn maggot, *Hylemyia cilicrura* Rd. (*Phorbia fusciceps* Zett.) was found by Mr. E. G. Kelly seriously damaging planted kafir seed at Olathe, Kansas. A single repellent test conducted with tobacco compounds, using nicotine resinate, tobacco oil, and nicotine sulphate (40%), on Commercial White corn, indicates that they may be of some value. The nicotine sulphate which had a strong odor at the end of the test had not injured germination, and in comparison with the check, had repelled the larvae. Further tests are desirable to make this conclusive.

Pheidole sp. (Hym.).—A species of *Pheidole* did considerable damage to planted sorghum as well as corn seeds at Manhattan during May and early June. Their work was evident on the surface by small mounds which in most cases were covered with fine white particles of the seed carried to the surface. The damage is quite similar to that of *Solenopsis molesta*, the ants evidently preferring the oily parts of the seed, leaving the starch in finely chopped bits. As high as 21 percent of injury was noted (Red kafir) and 19 varieties were attacked.

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CONTROL OF THE STRAWBERRY LEAF-ROLLER IN THE MISSOURI VALLEY

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INTRODUCTION

This paper is the result of work done in Kansas in 1917 and 1918, and in Iowa in 1919, by the writer while engaged in truck-crop insect investigations in the Bureau of Entomology, United States Department of Agriculture. The Strawberry leaf-roller (*Ancylis comptana* Fröhl.) in the adult stage is a small reddish brown moth with intricate markings; the larva, a nearly smooth caterpillar, slender, and reaching a maximum length of one-half inch. The larvae vary from light green to dark olive green. The species is distributed over all strawberry growing regions of North America.

The life-cycle stages in summer in southern Kansas are about as follows: egg, 6 days; larva, 22 days; pupa, 7 days. Several days are required for the pre-oviposition period, and a generation in summer required about 40 days. Stages are much longer in cool weather. R. L. Webster[1] has secured an average of 75 eggs per female in the insectary, and an average adult life of 10 days. The pale green egg is deposited on the leaf; the larva feeds, usually on the under surface, for about a week after hatching. It then draws the leaf together and webs it up, working on the upper surface. In this protected situation, it feeds and grows, and if not disturbed, will reach the adult stage before leaving. It never eats through the leaf, but injures it by webbing and feeding on the surface.

The nearly grown larva hibernates in the leaves and pupates early in the spring in Kansas, emerging during April. It seems likely that four generations occur, but that some of the last larvae of the third

[1]Webster, R. L., 1918. Journal Econ. Entom.. Vol. 11, pp. 42-45.

generation hibernate before pupating, and that in long seasons a small fifth generation may develop. Adults of the first generation appear by June 1, and those of the second generation begin appearing about July 10. In Iowa there are at least three generations and probably a partial fourth. The cool weather of late September and October appears to cause a cessation of pupation, and the larvae then present hibernate. After the intermission between the over-wintered and the first generation, all stages can generally be found in the field at any time until fall, though more abundant at some times than others. This is due to length of oviposition period and variation in development.

Injury

Usually only a few larvae may be found in a strawberry patch, and injury is very slight. In many cases, however, more or less damage is suffered by the plants, and occasionally a patch is found in which many or all of the plants have been killed. More than one larva to a plant will injure it noticeably. Injury is more severe in dry weather, since the plants have then less power of recovery. The writer has been unable to find the species in Kansas on any plant other than strawberry.

This leaf-roller shows marked fluctuations in numbers, due to numerous parasitic enemies of several hymenopterous and dipterous species. Winter cold, lack of food when larvae are numerous, and disease also reduce its numbers.

Outbreaks are usually rather sudden, local and short, lasting a season or less, though the species may be troublesome for several years in one locality. The grower can therefore undertake control measures, knowing that if the plants can be protected for the time, the leaf-rollers will soon diminish in abundance. The first generation is usually most injurious, but later generations often do considerable damage, especially in new plantings.

Control Problem

Control by spraying is based on coating the leafage with poison, which will kill the young larvae as they begin to feed. The older larvae are usually safe in their folded leaves. As all stages are present together during the summer, larvae and pupae present at the time of spraying will mature and deposit eggs for several weeks afterward. Some of these eggs will be deposited on unpoisoned foliage, since the plants will have put forth new leaves and rains will have washed off some of the poison. These conditions make it impossible to secure complete control with a single application under field conditions. When the first generation

of larvae, all about the same age, are present, it would seem that nearly all might be killed by a single spray at the time of hatching; but at this time rains are frequent and new leaves are being formed rapidly, so that control is actually more difficult then later. Complete control would necessitate keeping all foliage continuously coated with poison for several weeks. Before experiments were conducted, it seemed doubtful if enough larvae could be killed to reduce injury; but it was found that a single spray application gives the leaf-roller a substantial check and benefits the plants decidedly if they are being injured.

Results

The tests made by the writer were all on plots of less than one-half acre. Since the point to be tested was whether any arsenical would give satisfactory control, dry lead arsenate at the rate of 2 pounds to 50 gallons of water was applied, using a compressed-air sprayer. Half the strength would probably do just as well. In all except the first two tests, resin soap was used as a "spreader" and "sticker." In each case equal sprayed and unsprayed areas were counted over. Some difficulty was encountered in finding infestation severe enough for experiments. In plots 1, 2 and 4 some larvae were present at spraying time but had disappeared before counts were made.

Table of Results

Expt. No.	Locality	Date of spraying	Date of counts	Results	Percentage of Control
1	Wichita Kans.	May 2 1917	June 13	No leaf-rollers on sprayed or unsprayed area	----
2	Ogden Kans.	Aug. 11 1917	Sept. 8	No leaf-rollers on sprayed or unsprayed area	----
3	Wichita Kans.	Sept. 13 1917	Sept. 28	On sprayed area, 41 leaf-rollers on unsprayed area 120	66%
4	Troy Kans.	Jun. 25 1918	Jul. 16	No leaf-rollers on sprayed or unsprayed area	----
5	Muscatine Iowa	May 2 1919 and May 7	June 2	On sprayed area, 55 folded leaves, on unsprayed area, 125 folded leaves	55%
6	"	July 16 1919	Aug. 8 1919	On sprayed area, 4 leaf-rollers, on unsprayed area, 19	79%
7	"	July 16 1919	Aug. 5 1919	On sprayed area, 8 leaf-rollers, on unsprayed area, 24	67%
8	"	Aug. 14 1919	Sept. 2 1919	On sprayed area, 2 leaf-rollers, on unsprayed area, 5	60%

A weighted average of the above gives 63% control from a single spray.

The only large-scale spraying against the leaf-roller observed by the writer was that done in 1918 by Mr. F. W. Dixon at Holton, Kans., on about 60 acres of strawberries on his nursery farm. Leaf-rollers were first noticed in numbers in the fall of 1917, and began to be very injurious the following spring. Injury was aggravated by drouth, which was also

favorable to spraying. Mr. Dixon used a modern orchard sprayer with a row attachment. Three applications of lead arsenate were made; about June 15, July 20 and August 15, respectively. Several acres were left unsprayed the first time and nearly all plants in this area were killed. Many larvae were present on the sprayed area, but their numbers were so reduced that little injury was accomplished. This first application, in the writer's belief, saved a large portion of the plants. The second and third sprays were applied to all the strawberry acreage. The leaf-rollers were held in check all season. Though some larvae were always present, serious injury was averted. They became scarce by fall and were not troublesome in 1919. These results in large scale spraying by a grower are very gratifiying, especially considering the unusual severity of the outbreak. Although 100 percent control was not achieved, injury was effectually checked.

Recommendations

Lead arsenate with a soap spreader is well adapted to control of the leaf-roller, adhesiveness being especially desirable. Any fairly good spraying apparatus will do to apply it, and underspraying is unnecessary. The grower should spray only when the insect threatens to assume injurious numbers. One or two applications as the plants begin blossoming will reduce the numbers of the first generation, and probably also of saw-fly larvae if present. Growers will be reluctant to spray after berries begin setting. Should injury continue after harvest, further sprays should be applied. Mowing and cultivating aid in control where practiced, but are not always sufficient. Leaf-rollers should not be allowed to injure the plants during summer and fall, as the plants which will bear next year's crop are then developing. New plantings are very liable to injury late in the season.

Since one application gives about two-thirds control, several at short intervals should bring an outbreak to an end so far as serious injury is concerned. There is little advantage in spraying at intervals of less than two weeks in dry weather in summer and fall, but in rainy weather shorter intervals are better. Sprays a month apart during the summer have given practical control of the worst outbreak the writer has seen, though more frequent applications would probably have given more nearly perfect control.

Spraying as outlined throughout the season, both before blossoming and at intervals from midsummer until early fall, will protect the crop against unusual outbreaks. Usually, however, such frequent spraying

will not be necessary; in many cases it will not be needed at all, and in others one or two applications will suffice to protect the plants until the outbreak subsides. Spraying is not necessary nor profitable when leaf rollers are few, but it is an effective means of combating them when they rise to injurious numbers.

HOST PLANT SELECTION BY HESSIAN FLY[1] (*PHYTOPHAGA DESTRUCTOR* SAY.)

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In connection with the Hessian fly investigations at Centralia, Illinois, for the Fall of 1921, two sowings each of wheat, barley, rye, and oats were made to determine the relative attractiveness of these grains to the adult flies for oviposition and to obtain comparative data on larval infestation. Identical preparations were made for both series with respect to orientation of the plots and the date of sowings.

I. Sowing September 1.

Plants of this sowing appeared above ground on September 10. On this date fifty plants from each plot were marked and numbered for daily examination during the emergence period of the Hessian fly. The eggs found on these plants were carefully removed and recorded as found. The counts for the series are shown in Table I.

Table I—Daily Egg Counts

Date	Wheat	Barley	Rye	Oats	Total
Sept. 11	15	7	2	0	24
14	7	0	0	0	7
15	1	0	0	0	1
24	1	0	0	0	1
28	56	9	23	3	91
29	85	23	142	7	257
30	58	0	7	0	65
Oct. 1	11	0	6	0	17
2	195	19	56	0	270
3	170	15	42	0	227
4	111	8	5	0	124
5	124	19	20	0	163
6	651	57	173	0	881
7	9	0	0	0	9
8	81	41	69	0	191
10	68	12	35	0	115
11	17	0	0	0	17
12	9	0	0	0	9
15	29	5	0	0	34
16	38	9	0	0	47
Total	1736	224	580	10	2550
Per cent	68.0	8.8	22.8	.4	100

It was noted during the days from the first appearance of the plants

[1]Published by permisssion of Secretary of Agriculture.

above ground on September 10 to the period of injury by developing fly larvae that the root systems of the individual plants were steadily enlarging and that excessive tiller formation was becoming more pronounced. Rye in particular showed rapid tiller formation. Infestation counts were made November 25th after the plants had reached the maximum growing period with the advent of winter. An adaptation of the five linear foot method was used for selecting plants for examination. By this method samples are taken to include all plants from five linear feet of drill row, each foot taken separately and at random. Infestation data thus obtained are given in Table II.

TABLE II—INFESTATION DATA SEPT. 1, SOWING

Sowing	Plants		Culms		Larvae						Puparia Per culm		Total
					Size			Per culm					
	Examined	% Infested	Examined	% Infested	Small	Half grown	Mature	Max.	Aver.	Total	Max.	Aver.	
Wheat	50	96	135	44	4	0	85	9	2	89	26	5	274
Barley	50	64	210	20	3	3	16	2	2	22	4	1	46
Rye	50	6	410	0.7	0	0	1	1	1	1	3	2	4
Oats	50	0	62	0	0	0	0	0	0	0	0	0	0

A detailed chart showing the infestation data for each individual plant for the fall brood of flies is not possible on account of its large size. However, a summary showing the more important features is given in Table III.

TABLE III—SUMMARY OF DETAIL INFESTATION DATA

Plot	% Plants Infested by eggs	Eggs per Infested Plant			% Plants infested by larvae	Larvae per Infested Plant.		
		Max.	Min	Aver		.		Aver.
Wheat	100	118	4	35	96	26	1	8
Barley	74	17	1	6	64	7	1	2
Rye	90	44	1	13	6	3	1	2
Oats	8	4	1	3	0	0	0	0

II. Sowing September 14.

Plants of this sowing appeared above ground on September 20th. From this date and throughout the period of activity of the Hessian fly for the fall, ten plants were examined daily for each plot. Plants were selected at random and the accumulated egg masses recorded. Condensed results from the examinations are given in Table IV.

TABLE IV—ACCUMULATED EGG COUNTS

Date	Wheat	Barley	Rye	Oats	Total
Sept. 28	5	0	0	0	5
29	10	0	5	0	15
30	15	0	4	0	19
Oct. 1	29	7	25	0	61
2	31	9	18	0	58
3	51	12	16	0	79
4	110	19	17	0	146
5	157	26	12	0	195
6	161	20	18	0	199
7	139	10	28	3	180
8	198	8	39	6	251
9	170	50	41	0	261
10	232	29	37	1	299
11	126	15	11	0	152
12	104	12	58	0	174
13	284	23	34	0	341
14	159	48	51	0	258
15	77	18	29	0	124
16	129	24	3	0	156
17	45	24	0	0	69
18	16	6	0	0	22
19	6	2	0	0	8
Total	2254	362	446	10	3072
Per cent	73.4	11.8	14.5	.3	100

Infestation counts for this sowing were made November 4th before the plants had stooled excessively, though at this time the rye plants were sending out many succulent tillers. The results thus obtained are given in Table V.

TABLE V—INFESTATION DATA, SEPTEMBER 14 SOWING

Sowing	Plants		Culms		Larvae						Puparia		
					Size			per culm			Per culm		
	Examined	% Infested	Examined	% Infested	Small	Half grown	Mature	Max.	Aver.	Total	Max.	Aver.	Total
Wheat	100	98	100	98	58	154	317	18	5	329	9	2	33
Barley	100	62	100	62	60	34	16	6	2	110	2	1	4
Rye	100	8	100	8	6	4	5	4	2	15	0	0	0
Oats	100	0	100	0	0	0	0	0	0	0	0	0	0

SUMMARY

Observations from two series of plots made daily throughout the full emergence period of the Fall of 1921 at Centralia, Illinois show that adjacent and identical prepared plots of wheat, barley, rye and oats are subjected to fly attacks in varying degrees.

The order of selection for oviposition runs in descending order wheat, rye, barley and oats. From data in which daily egg counts were made from a numbered series of plants (Table 1) the total number of eggs being considered 100%, wheat received 68%, barley 8.8% rye 22.8% and

oats .4%. Likewise accumulated egg counts made from a constant number of plants (Table 4) show that wheat received 73.4%, barley 11.8%, rye 14.5% and oats .3%.

Resultant larval infestation from the fall oviposition of the Hessian fly on wheat, barley, rye, and oats was primarily manifest in wheat and barley. Rye, though second in selection for oviposition, was scantly infested and oats not at all. The percentages of plants infested from these two series of plots (Tables 2 and 5) were for wheat 96 and 98, for barley 64 and 62, and for rye 6 and 8 respectively.

INJURY TO BELL PEPPERS BY *BLAPSTINUS CORONADENSIS*[1] BLAISD. AND *B. DILATATUS*[1]

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During the first week of September, 1921, the writer's attention was called to some fields of young bell peppers near La Habra, Calif., which examination showed were being damaged by tenebrionid beetles feeding on the stems at the surface of the ground. It was evident that individual beetles did not do much feeding at one time, but because of their numbers around many plants and their continuous feeding, serious damage had resulted. This injury varied from a hole or two into the epidermis to the complete girdling of the stem for an inch or more. In severe cases, although the plant continued to grow for some time, it soon broke off because of the weakened stem. In other cases, when the process of feeding was slow, the wound healed over and the plant recovered. The more seriously infested part of the fields suffered a damage in killed plants of at least 25 per cent, but the average for the entire fields would not be over 5 per cent. Many more plants were injured, but were not killed.

The field most seriously damaged had been cultivated for 5 years. Opposite was a young lemon orchard separated by a dirt farm road which had not been plowed for several years. The greatest damage was to the rows near this old road. The soil was a rather heavy clay loam, the elevation about 500 feet, in the edge of a range of foothills. About half a mile away, near the top of a hill, 100 feet higher, was another field similarly but not so seriously damaged. Various counts indicated a maximum number of 75 beetles around the stem of a single

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[1]Identifications by Dr. F. E. Blaisdell.

plant! It was not uncommon to find a dozen or more beetles, while the average in the parts of the field suffering damage was about 6 beetles to a plant.

Of the two species concerned in this infestation, *Blapstinus coronadensis* and *B. dilatatus*, the former was by far commoner.

A number of experiments were made with different materials which were placed on the ground around the stem of the plant. Among the materials used were ground tobacco, nicotine dust, nicotine dust and calcium arsenate, Bordeaux mixture (both wet and dry), Bordeaux mixture with nicotine dust, and hydrated lime. Some were merely applied to the top of the ground, while others were covered with soil after application. Later examinations showed that the wet sprays were valueless, but that dry dusty material had a decided deterrent effect. This was checked up by using hydrated lime on a larger scale, with results as follows:

Check Undusted	33 plants with beetles around stem; 2 plants with no beetles.
Dusted	6 plants with beetles around stem; 29 plants with no beetles (5 of these plants did not have lime thoroughly about stem)
Check Undusted	23 plants with beetles around stem; 13 plants with no beetles.

Field observations confirmed these results. If the lime were so applied as to cover the ground completely around the stem, the beetles ceased to feed.

For applying the lime, a bellows type of hand duster was used. With the feed wide open, a single puff of dust thoroughly covered the ground on one side of the stem. The operator proceeded up the row, giving a puff to each plant, and then came back on the same row, so as to cover the ground on the opposite side.

Very little feeding was observed after the lime was applied. A number of plants died, having been previously injured, so that the increased weight of the growing top caused them to break off.

The pepper fields were under irrigation, and the one most seriously damaged was level with a gentle slope to the South. To test the possibility of killing the beetles by flooding the field, a number were brought to the laboratory and placed on soil submerged in water. The beetles were very active for over an hour, when some became quiescent. These

were removed, and soon recovered. Others continued to move, although with less vigor, for three hours, and were then allowed to remain over night in the water. The next morning practically all of them were still alive, although they had been under water for 18 hours. This indicated that flooding fields infested by these beetles would be useless as a control measure.

Dr. F. H. Chittenden, Bureau of Entomology, informs the writer that on two occasions other species of Blapstinus have been destroyed by poisoned baits used by employees engaged in Truck Crop Insect Investigations. The first of these experiments was performed by Mr. H. M. Russell in the spring of 1911 in combating an outbreak of cutworms on sugar beet in southern California. Bran, shorts and Paris green were used in the preparation of this bait. It was applied May 1 and when the infested fields were examined later, in addition to an abundance of dead cutworms, many Blapstinus beetles were found lying dead beside the poisoned bait.

UTILIZATION OF SYSTEMATIC OBSERVATIONS ON BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER) AND CURLY LEAF OF SUGAR BEETS

By Edward A. Schwing, B.S. and William J. Hartung, B.S.
Spreckels Agricultural Experiment Station

Sugar companies demand information as to the number of beet leafhoppers (*Eutettix tenella* Baker) present during the spring invasion of the pest into the beet fields, and also at very frequent intervals, the extent and progress of curly leaf (curly top or blight) which this insect transmits. Reliable information must be at hand for economic reasons. The desultory manner of gathering and recording this information in the past, resulted in data of very little value to the sugar companies as a reference to the average number of leafhoppers for a certain number of beets and the possibility of securing a marketable crop. During 1920, the recording of information was put on a sound workable basis with all of the essential facts and related data. The following headings were found to be most satisfactory in tabulating the data:

Location	Date	Weather conditions	Size of beet	Curly leaf	Number hoppers per 100 ft. of beet row
Ranch 3 Doud Tract	May 4-21	8:30 a. m. sunshine, quite	6 leaves unthinned	20%	15 adults

In checking up the percentage of blight in a field, two rows of 50 beets were counted, and the average percentage of curly leaf was computed. Curly leaf was determined by examining the youngest or innermost leaf of a beet for the earliest visible symptom; namely, the transparent network of minute veins.

The determination of the number of beet leafhoppers to 100 feet of beet row is a difficult and tedious task. Trial after trial by sweeping with an insect-net proved that this method of ascertaining the number of insects in a beet field was inaccurate. The method which we employed was to disturb the foliage with the hand and carefully examine each beet and surrounding soil for leafhoppers, while the observer crawled along the row of beets on his hands and knees. Months of this experience makes one very adept and the possible error is reduced to a minimum. Time after time observers have checked the results of each other and the counts of the number of hoppers were so nearly the same, that it is felt that the data thus obtained is reliable.

In the Salinas Valley, where this work has been carried on systematically weather conditions are an important factor in ascertaining the number of insects. Early in the morning, when it is cool and still quiet, the adults in the beet fields are sluggish and easy to count. In the Salinas Valley a daily wind blows from about 10 A.M. until evening. When this wind prevails, the hoppers are difficult to find and the work for the day must cease if accurate results are to be recorded. During cloudy, cool mornings the determinations are very accurate; on warm, sunshiny mornings, the activity of the leafhopppers makes observation more difficult and less accurate.

During 1920, the number of adults in the beet fields of the Salinas Valley remained almost constant from the time that the invasion of the pest occurred in early May until the second brood adults made their appearance during the last week in June. Nymphs began to appear in early June and increased as the month progressed. The same condition with slight modifications was found to be true in the present season of 1921.

The size of the beet at the time that the leafhoppers appear in considerable numbers in the fields and the relative number of hoppers present have a direct bearing on the tonnage harvested. At King City three beet fields on which data was kept during 1920, showed the effect of the time of planting. One tract planted about April 1, was being thinned about the time that the spring brood adults flew into the beet fields during the early part of May. By June 26, these beets were all blighted,

and at the end of the season a crop of less than one ton per acre was harvested. Beets planted in January, 1921 in the same field averaged eight tons per acre. On a second tract planted about the last of March, 1920 the beets were still unthinned when the spring brood made its appearance. Blight made quick inroads on this area also, amounting to 100% by July 24. The yield from this field was 3.1 tons per acre which hardly paid for harvesting the crop. A third tract was planted in February. When the bugs appeared, these beets were making a thrifty growth and continued to grow but did not show the effect of curly leaf until much later in the season. These beets did not show 100% blight until August 20, and before that time they were ready to harvest. Even though a delay of the last irrigation due to power shortage reduced the crop, a yield of over seven tons per acre was secured from this field.

In the fog belt districts more leafhoppers were present and a higher percentage of curly leaf occurred in early planted beet fields than in fields planted after the invasion of the pest had occurred in the Salinas Valley. March plantings showed 80% curly leaf on July 23, near Chualar, while beet seeds which germinated after May 1, showed only 3% blight on August 5. At Santa Rita 60% of the early planted beets were blighted compared with 3% in an area replanted on account of the disease in the same field. The same condition occurred in the San Juan Valley; where, on one side of the river, March and April plantings were destroyed by curly leaf, while on the opposite side of the river late plantings produced a good crop.

The two following questions are frequently asked by growers: (1) Can a profitable crop of sugar beets be grown where the beet leafhopper is present? (2) Will it pay to allow beet fields that are attacked by leafhoppers to complete their growth, or is it advisable to plow up the beets and plant some other crop? Systematic observations show that under semi-arid conditions near King City, Salinas Valley, beets planted before March 1, with proper cultural methods and soil moisture, will produce a fair yield in blight years. If beets have not been thinned or have just been thinned, when the adults invade the fields, the possibility of a crop is very problematical; in fact, a failure is almost a certainty when one leafhopper to 20 beets are present. If the beets have been thinned and possess not over 16 leaves, with the same number of insects, the crop is still doubtful and the beets may or may not pay for harvesting. In the case like the latter, beets had best be left to complete their growth if there is doubt as to the success of a crop planted at this time. In the fog belt districts of the Salinas Valley where climatic conditions

are favorable, replanting may be resorted to when the first planting becomes badly blighted in the early part of the season.

Systematic records of this nature should be continued in years when the beet leafhoppers are at their maximum in number, and through the interval between outbreaks so that all conditions can be recorded. Better decisions on crop prospects with reference to curly leaf and the number of beet leafhoppers can be rendered early in the season with more data available.

THE EFFECT OF ACTIVITY ON THE LENGTH OF LIFE OF HONEYBEES

By E. F. PHILLIPS, *Bureau of Entomology*

That honeybees live longer when they are least active has been known for many years. This is especially evident from the fact that during the heavy honey-flow the worker bees live about six weeks while during the winter they may live four times as long. It may be that this difference is in some degree associated with certain physiological conditions which need not be discussed at this time, but it seems clear that the chief difference is in the amount of work which they are called upon to do. It has for a number of years been believed that the greater the activity of the bees, the shorter their term of life.

In connection with some experiments to determine the availability of various carbohydrates as food for worker bees, it was noted that the bees used as checks on the experiments, and which were given no food whatever, lived for different periods, taking an average of the daily death rate. In the first series of experiments (August 1914) the bees without food averaged 1.74 ± 0.0377 days. In the second series (September 1914) the average for unfed bees was 4.34 ± 0.0662 days. For the third series (September 1919) the average was 1.375 days. For the fourth series (May 1922) three lots of bees without food were put under different conditions, and it is the purpose of this note to discuss these results in detail. In a fifth series (May 1922) the average for the bees without food was 2.4164 ± 0.0216 days.

In the fourth series three lots of worker bees were placed in wire-cloth and wood cages and each cage was provided with a water bottle but the bees were given no food after the beginning of the experiment. The small number of drones in each cage is omitted from the following figures:—Lot No. 1 (274 bees) was placed in a dark room in the basement of the laboratory, light being introduced into the room once daily when the

dead bees were removed for counting. Lot No. 2 (294 bees) was placed in a room of the laboratory within one foot of a 40 watt Mazda light which burned night and day until all the bees were dead. This caused excessive activity as long as the bees were capable of it. Lot No. 3 (248 bees) was kept in a room of the laboratory without artificial light and where the direct sunlight did not strike the bees at any time. The light was not strong as the exposure of the room is to the north and east and the window on the east side is partly shaded by a tree. The bees in this lot were quite noisy with periods of rest.

The worker bees in the dark room lived an average of 2.1934±0.0286 days. The temperature in this room varied between 18.8° and 20.4° C. during the life of these bees. The last bee died on the fourth day. The bees of Lot 2 under constant light lived an average of 1.1293±0.0194 days, the last bee dying 42 hours after the installation of the bees. The average temperature as recorded by a thermometer lying beside the cage varied between 23.1° and 27.2° C. The bees kept in diffused light in the laboratory lived an average of 1.2261±0.0291 days, the last bee dying 51 hours after the beginning of the experiment. The temperature in this room varied between 22° and 24° C.

These bees were installed at 1:30 P.M. on May 10. At 6:30 P.M. on the next day one drone in the lot under constant light was still able to walk and two worker bees were moving their antennae. At 8:30 P.M. on the 11th one of the workers moved slightly. At 8:00 A.M. the next morning all were dead. In the lot kept in diffuse light during the day five workers were seen moving feebly on the morning of the second day and they were all dead at 4:00 P.M. Those in the dark room became sluggish also but not so rapidly. The death rate by days is recorded in the accompanying table:—

TABLE SHOWING DEATH RATE OF WORKER BEES WITHOUT FOOF

Day	Dark Room Dead	Dark Room Temp. C	Constant Light Dead	Constant Light Temp. C.	Diffuse Light Dead	Diffuse Light Temp. C
1	42	20.4	256	27.2	182	24.0
2	141	19.8	38	24.0	66	22.0
3	87	18.8				
4	4	18,8				
Totals	274		294		248	

That any animal will starve to death in so short a time as is here indicated is startling. That they died of starvation is obvious from the fact that in all the series recorded there were other lots of bees which were given various sugars as food on which the term of life was decidedly

increased. These data were obtained for another purpose and need not be given here in detail, but it may be stated that in the dark room at the same time that the bees without food were in it, a cage of bees containing 192 worker bees lived an average of 6.6719±0.2089 days on cane sugar (sucrose C.P.). There were no cages of bees with food in connection with the other two lots without food recorded.

To determine whether the starved bees had completely utilized their food reserves, a few of the starved bees were examined. Some of the results are given herewith. One bee which had died in the dark room without food showed pollen grains in the rectal ampulla which were mostly empty. Stained with Sudan III, many of the apparently empty pollen grains showed small fat globules and there were innumerable small fat globules, as shown by this stain, still remaining free in the contents of this organ. The ventriculus was black in color and was filled with a disorganized mass of material with some pollen grains, both full and empty. Here also fat globules were seen in the full, partly empty and apparently empty pollen grains, but they were less numerous than in the rectal ampulla. Since it has not been fully established whether worker bees are able to digest fat, it may be that this food material is not available to them.

After the removal of the alimentary canal, the fat tissue lying dorsal to the wax-glands was scraped up and stained with Sudan III. These cells were full of fat globules, in some cases so full as to distort the cells. It would appear that the bees did not draw fully on this food reserve during the time that they still lived. That bees are able to utilize the fat stored in the fat body is scarcely to be doubted, in view of the occurrences during metamorphosis and larval life. In another bee which was examined in the same manner the same things were seen. In addition the fat body was stained with iodine but no trace of glycogen could be distinguished. It would appear that starvation had occurred while there was still some available food reserve in these bees, possibly occurring too rapidly to permit the bees to draw on this material.

Bees that had died in the cage under constant light were also examined and showed no glygogen in the ventral fat cells but did show fat in the ventriculus, in the rectal ampulla and in the ventral fat cells. None of the bees kept in the laboratory in diffuse light were examined in this way. In a private communication, Mr. R. E. Snodgrass states that he has observed fat bodies of starved caterpillars (species not recorded) in which the fat body is reduced in size but the remaining cells show a normal amount of fat, apparently as much as they can hold.

It therefore appears that rapidity of death by starvation occurs in direct proportion to the work the bees are called upon to do, and that when death from starvation occurs rapidly there is still a food reserve which has not been depleted. The relation between the work done and the death rate is quite in keeping with what has been so frequently observed for normal bees, namely that the normal term of life (barring accidents) is determined by the amount of work which the individual is called upon to do. Since bees in cages are not under normal conditions, they probably do more work than bees under ordinary hive conditions, as indicated by the fact that those on satisfactory foods do not live as long as bees are known to live in the hive. The longest period of life in these cages that has come to the writer's attention were some that lived for thirty days in a cool laboratory room. In the series here recorded, the last bee on sucrose died on the seventeenth day.

DUSTING VERSUS SPRAYING FOR THE CODLING MOTH IN WALNUTS

By H. J. Quayle

During the past three years a considerable acreage of English walnuts in Southern California has been dusted for the codling moth. During the first year standard or acid arsenate of lead was used but which was later abandoned because of the injury to the walnut foliage. Only basic or neutral arsenate of lead can be used with safety on English walnuts at least in the coastal sections of Southern California. In connection with the writer's investigation of the codling moth in walnuts, spraying was compared with dusting as a means of control. For this purpose four different orchards have been utilized where plots were sprayed and dusted at different times, and plots left as checks, during the past three seasons. A tabular summary of the results of dusting and spraying on two of these tracts for one season, which are representative, is given below:

	Orchard A	*Orchard D*
Reduction in wormy nuts by one spraying	5%	18.3%
" " " " " " dusting	3.1%	11.5%
Infestation of check plot	6.1%	22.0%
Average production per tree	157 lbs.	60lbs.
Increase in sound nuts per tree by one spraying	7.85 "	11 "
" " " " " " " " dusting	4.86 "	6.9"
Value of spraying per tree, nuts at 25c	$1.96	$2.75
Value of dusting per tree, nuts at 25c	$1.21	$1.72
Cost of spraying per tree	.74	.45

	Orchard A	*Orchard D*
Cost of dusting per tree	.75	.44
Amount of dust per tree	10 lbs	6 lbs.
Amount of spray per tree	33 gals.	20 gals.
Net returns from one spraying per tree	\$1.22	\$2.30
" " " " dusting " "	.46	1.28
" " " " spraying " acre	18.30	46.00
" " " " dusting " "	6.90	25.60
Net difference per acre in favor of spray	11.40	20.40

TWO INJURIOUS FRUIT MITES IN PENNSYLVANIA

By S. W. Frost, *Ent. Research Laboratory, State College, Pa.*

Two mites have been found injurious on fruit trees in Pennsylvania. One is the European Plum Mite, *Paratetranychus pilosus* Can. & Fran., which was previously recorded in the Journal[1] as a pest chiefly on apple and plum although it occurred to some extent on cherry and peach. A second mite, *Phyllocoptes cornutus* Banks has recently been found very abundant in parts of the state on peach. This species was first noticed in Cumberland county, Pennsylvania, in 1921, by Mr. W. A. McCubbin, Deputy Director State Bureau of Plant Industry, Harrisburg, and was thought at first to be a silver leaf resembling closely the European silver-leaf disease. Further examination and a consultation with an entomologist has identified the injury with that of a small mite which Mr. Nathan Banks has previously described and recorded from this country. It has also been found in Lebanon, Dauphin, and Adams counties and further examination will no doubt reveal its presence in other parts of the state.

Both species produce characteristic injury upon their hosts. The European Plum Mite causes the leaves to turn yellowish and later become bronzy in color. The silver Leaf-mite of peach causes the leaves to become silvery and later become leaden in color. Both species have a tendency to flatten the leaves so that the appearance from a distance is very different from the normal foliage.

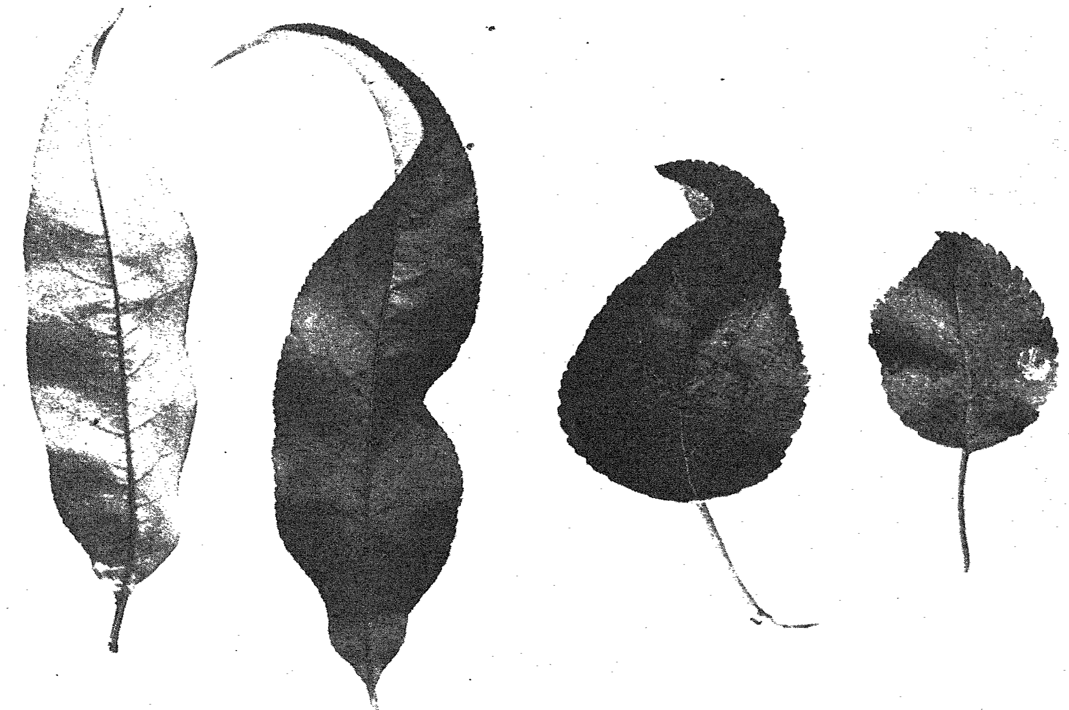
Scientific Notes

Aroostook Potato Insects[2]. Since aphids have been found to transfer potato mosaic and leaf roll (Bulletins 292, 297, and 303 Me. Agr. Exp. Sta.), and certain other insects with piercing and sucking mouthparts are being viewed with suspicion,

[1]Journ. Econ. Entomology, Vol. 12, pp. 407-408, 1919.

[2]Papers from the Maine Agricultural Experiment Station: Entomology No. 111.

PLATE 6



Silver leaf of peach

Normal peach leaf

Normal apple leaf

Red spider on apple

a list of Hemiptera frequenting potato vines may prove suggestive to persons interested in experimental work with disease transference. The following insects were collected from potato at Presque Isle, Aroostook County, Maine in 1921 by the writer and field assistant, and were determined by Dr. Herbert Osborn. While certain of them may have been resting on potato vines by chance, most of them were common enough to be taken repeatedly though none, except *Lygus pratensis*, were abundant enough the past season, to assume significant economic importance. It will be noticed that *Empoasca mali* is conspicuous by its absence[1]. *Cosmopepla carnifex*, July 15; *Canthophorus cinctus*, July 15; *Adelphocoris rapidus*, July 15-25; *Poecilocapsus lineatus*, July 15; *Lygus pratensis*, July 15-Sept. 8; *Philaenus spumarius*, July 15-Aug. 20; *Philaenus lineatus*, July 15; *Clastoptera proteus*, July 15; *Ceresa basalis*, July 25-Aug. 20; *Platymetopius acutus*, July 15; *Acocephalus nervosus* (*striatus*), July 15-Sept. 8; *Phlepsius apertus*, July 31; *Graphocephala coccinea*, Aug. 6; *Agallia sanguinolenta*, July 31.

The following predaceous damsel-bugs were present: *Nabis roseipennis*, Aug. 25.-Sept. 8; *Nabis ferus*, July 15-Sept. 8; *Nabis limbatus*, July 15; *Nabis subcoleoptratus*, July 31; *Pagasa fusca*, July 31.

Euschistus tristigma, Sept. 11; and *Pentatoma juniperina*, July 11, were found feeding on potato vines at Caribou, Aroostook Co. in 1906 (Bulletin 134, Me. Agr. Exp. Sta.).

EDITH M. PATCH

Mexican Bean Bettle: We have just received what appears to be the first official record of the Mexican Bean Beetle, (*Epilachna corrupta* Mull.) in the state of Utah in some material sent in for determination. This material was collected at Rockville, Utah, July 5, 1922, by V. M. Tanner, St. George, Utah. Incidentally, this may also be the most westerly infestation of this insect yet reported.

GEORGE M. LIST
Colorado Agricultural College, Fort Collins, Colo.

The Value of Carbon Bisulphide in Combating Tent Caterpillars and Mosquitoes. In the use of fire torches for the destruction of tent caterpillars, often a considerable number of smaller twigs and limbs are damaged or killed by the heat, and ground fires may be started from the droppings from the torch.

Carbon bisulphide seems to be very effective in killing these pests and may be used as follows: Take a long pole with a blunt point at the end, place on this point a piece of raw cotton well saturated with carbon bisulphide. This should be pushed into the web and, by turning the pole, be left inside where the fumes will almost immediately kill all the occupants.

In the control of mosquitoes, gasoline is objectionable on account of it making the water unfit for many purposes. Last June the water in a ten-gallon tub was found to be swarming with the larvae of mosquitoes. A few drops of carbon bisulphide was poured into the receptacle and it sank to the bottom, resembling pearl-like bodies. Within a few minutes there was undue agitation among the insects and at the end of a half hour all were dead and floating on the surface of the water. The carbon bisulphide did not give the slightest taste or smell to the water.

A. K. FISHER, *U. S. Biological Survey*

[1]Reported as "fairly common" in beans at Houlton (Bul. 236 Me. Agr. Exp. Sta.)

Sticky Bands in France: In No. 27 of the current volume of the "Comptes Rendus des Séances de l'Académie d'Agriculture de France," M. Paillot, Director of the Southeast Entomological Station of France, presents an interesting paper on the sticky bands which are being used against the *Cheimatobia*. He experimented in former years successfully with American tanglefoot, but on account of the expense of the latter, he has recently been experimenting. He finds that the mixture prepared by Collins and Hood of the Gipsy Moth laboratory at Melrose Highlands is very effective, preserving its sticky quality for a very long time, and at the same time is much cheaper than the tanglefoot. He endeavored to have the same mixture prepared by a firm in Lyon, but without perfect success, the mixture drying too rapidly in the open air. He hopes to be able to prepare a mixture comparable to the Collins and Hood mixture, as described in Bulletin 899 of the Bureau of Entomology, since the substances of which it is composed are readily obtainable in France. He proposes to use it, not only against the *Cheimatobia*, but against the gipsy moth whenever outbreaks of the latter species occur in France.

L. O. H.

Outbreak of the Birch Skeletonizer: The birch skeletonizer, *Bucculatrix canadensisella* Chambers, is abundant in Connecticut this season and acres of *Betula populifolia* in New Haven County were brown in September. Other species of birch are attacked, but not skeletonized or injured to the same extent. W. E. B.

Spread of Gipsy Moth in Connecticut: Last winter's scouting revealed an extensive spread of the gipsy moth in Connecticut, apparently due to wind-spread in the spring of 1921 and in some cases old egg-masses were found showing that the wind-spread occurred in 1920. Most of the infestations are small and scattered, but it is now necessary to spread our control work over more than three times the area covered heretofore, which will be difficult without a larger appropriation. Windham, Tolland and Hartford Counties are now generally infested, all of New London County except two towns in the southwest corner, the northern part of Middlesex County, northern part of Litchfield County along the Massachusetts border to the New York State line, and two towns in the northern part of New Haven County are scatteringly infested. Fairfield County has not yet been found infested. Of the 169 towns in the State, 95 are now covered by State and Federal quarantine instead of 26 a year ago. W. E. B.

Apple and Thorn Skeletonizer: The apple and thorn skeletonizer, *Hemerophila pariana* Clerck, was first found in Greenwich and Stamford, Connecticut, late in the fall of 1920, having been discovered in Westchester County, N. Y., two or three years prior to that date, where it had evidently been introduced in some way from Europe. On June 24, 1921, many unsprayed apple trees in Greenwich and Stamford, Conn., were brown and adults were found resting on the leaves and on daisies in the fields. Before the season ended, this insect was received at my office from many points in Connecticut and was observed at other places by members of the department staff, showing that it had already become distributed nearly all over the State. This pest has attracted a good deal of attention during the present season, and now (September 15) unsprayed apple orchards in New Haven County and the southern part of Hartford County look as if a fire had gone through them. On the other hand, the attack of this insect has been less severe in Greenwich and Stamford than in 1921. The injury to sprayed orchards is slight. W. E. B.

European Corn Borer Conference: On September 7th and 8th a party of forty-three officials, county agents and farmers from the state of Ohio visited the European Corn Borer Laboratory at Port Stanley, Ont. They arrived at Port Stanley from Cleveland on the afternoon of the seventh, coming across Lake Erie on the Ohio Fish and Game Commission's boat.

The morning of the eighth was spent in visiting the laboratory and then a trip was made in motor trucks to some of the more heavily infested fields. Stops were also made at the Dominion Government experimental control plots and at different fields where corn had been planted in accordance with suggestions made by the officers of the Entomological Branch. It was readily seen that late planted corn suffered less injury from the European corn borer as compared with that planted earlier in the season.

The object of the trip, which was organized by the Ohio Department of Agriculture, was to bring to the attention of the farmers and county agents of that state the necessity of cooperative action in sections where the European corn borer is present and doing extensive damage. The visitors returned to Cleveland by boat on the afternoon of the eighth.

The party was in charge of Mr. L. J. Taber, Director of Agriculture for Ohio, and included E. C. Cotton, Director of Plant Industry, Columbus; Prof. Raymond C. Osburn, Ohio University; Prof. Herbert Osburn, Ohio University; H. A. Gossard, State Entomologist; J. S. Houser, Assistant State Entomologist; T. H. Parks, Extension Entomologist, and N. E. Shaw, Columbus. Mr. W. A. Walton, Chief of the Division of Forage Insects, and Mr. L. H. Worthley, in charge of Corn Borer Control, of the United States Department of Agriculture accompanied the visitors.

Mr. L. S. McLaine, Chief of the Division of Foreign Pests Suppression and Messrs. Crawford and Keenan of the Entomological Branch and Capt. G. J. Spencer of the Ontario Department of Agriculture, conducted the party through the infested area.

THIRTY-FIFTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The 35th annual meeting of the American Association of Economic Entomologists will be held at Boston, Mass., December 28 to 30, 1922.

The day sessions will be held at the Massachusetts Institute of Technology, Cambridge, and at least one evening session will be held in the Auditorium of the Boston Society of Natural History.

Hotel headquarters will be at the Brunswick, Boylston Street, near Copley Square. As hotels are likely to be crowded during the Christmas holidays, members are urged to secure reservations by corresponding direct with the hotel at once.

During convocation week, it is planned to hold a joint meeting with the American Phytopathological Society. Members interested in medical entomology will hold a joint session with Section N, and the entomologists especially interested in extension work and in the Insect Pest Survey plan will hold special group meetings.

Applications for membership should be filed with the Secretary as early as possible, and should be accompanied with the fee of $3.50. Application blanks can be secured from the Secretary or the chairman of the membership committee.

A. F. Burgess, Secretary
Melrose Highlands, Mass.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1922

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, provided that at least 100 reprints be ordered at full price rates; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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The control of the mosquito nuisance in our most important National Parks which are visited by tens or hundreds of thousands of people each year will appeal to most tourists and to many others who remain at home. When the writer visited the Yellowstone National Park fifteen years ago this summer, mosquitoes were rather annoying around some of the permanent camps, and when asked to speak at one of the open fireside gatherings in the evening at one of these camps, he explained the biology and habits of mosquitoes and predicted the future control of this nuisance by Governmental agencies. As these species are local, it would not be so difficult a problem as it may seem to the uninitiated, to do away with most of the nuisance around the permanent camps and hotels and around the areas where public camping is permitted. Possiby some system of control is already in force, but if so the writer has not heard of it. It is gratifying to learn that the Canadian Government has already undertaken to control the mosquito pest in Rocky Mountain National Park as will be seen by another note in this issue. It is also gratifying to learn that these efforts are already bearing fruit, and that the spring work has greatly reduced the numbers of adult mosquitoes. A temporary laboratory has been established at Banff, and the Entomological Branch and the Park officials are working in close co-operation.

Our National Parks are considered a national asset. Some of them are not visited by tourists and may well be left in their natural condition. Other parks are maintained for tourists and in them the health and comfort of the visitors should be safeguarded. It is hoped that mosquito control may soon be inaugurated in other National Parks both in Canada and in the United States.

W. E. B.

It seems a far cry from roses to potatoes. Few would think of utilizing aphids for the location of roses. Only a specialist would dare to hold that a biological relationship existed between roses, potatoes and aphids and that the last named in turn may have an important part in the dissemination of a plant disease. Few specialists expect their studies to result in immediate or practical applications, though there is no question as to the basic utility of such investigations. Specialization in agriculture has brought about conditions here and there in the country where scientific knowledge is of great practical value. Those interested in an admirably presented story of investigation and accomplishment, should read the epic of the rose and the potato entitled: "Marooned in a Potato Field," which appeared in the August issue of the *Scientific Monthly*. This recounts the history of one of the many justifications of scientific work and is another striking instance of the need of effective co-operation among investigators in different branches of science.

Current Notes

Mr. W. L. Distant, a prominent Hemipterist, died at Wanstead, England, February 4, 1922, at the age of 77 years.

Mr. Ed. L. Ayers, formerly nursery inspector in Texas, has been appointed extension entomologist and pathologist of Florida.

Messrs. R. W. Moreland, J. W. Couch and Rowland Cowart of the Bureau of Entomology laboratory force at Mound, La., have recently resigned.

Dr. Carl J. Drake, formerly of Syracuse University, has been appointed State Entomologist of Iowa, and has already entered upon his duties.

Mr. A. F. Burgess, in company with Professor J. S. Houser, visited Cleveland, Ohio, on July 31, to examine the areas recently dusted by aeroplane.

Mr. Leland H. Taylor, graduate of the Massachusetts Agricultural College and of the Bussey Institution, has accepted a position as Instructor of Zoology, West Virginia University.

Mr. Theodore H. Frison, of the Japanese Beetle Laboratory, Riverton, New Jersey, has been appointed Assistant in the Department of Entomology of the University of Illinois.

Dr. Guy C. Crampton of the Department of Entomology at the Massachusetts Agricultural College, visited the field station of the Bureau of Entomology at Wallingford, Connecticut, July 7 and 8.

Severe outbreaks of the forest tent caterpillar are reported from New Brunswick and Manitoba, while from Quebec and Ontario the apple tent caterpillar is said to be very abundant this year.

Professor F. Silvestri, one of the foreign members of the American Association of Economic Entomologists, has just been made foreign correspondent in the Section of Agriculture and Natural History of the Academy of Agriculture of France.

Mr. Stanley W. Bromley, Massachusetts Agricultural College 1922, has been employed during the summer as assistant at the Wallingford, Conn., field station of the Bureau of Entomology. He will return to the Massachusetts Agricultural College this fall to take up graduate work in entomology.

Mr. G. E. Sanders, formerly of the Dominion Entomological Laboratory at Annapolis Royal, Nova Scotia, and later with the Dosch Chemical Co., Louisville, Ky., is now manager of the Deloro Chemical Company, Ltd., Deloro, Ontario, Canada.

According to *Science*, Dr. W. J. Holland, since 1898 director of the Carnegie Museum, Pittsburgh, has become director emeritus, and is succeeded by Mr. Douglas Stewart.

According to *Science*, Dr. W. H. Brittain, provincial entomologist of Nova Scotia, has been appointed a member of the council of the American Association for the Advancement of Science, to represent the Canadian Society of Technical Agriculturists.

According to *Science*, Mr. William Schaus of the U. S. National Museum, has been elected an honorary member of the Entomological Society of Brazil in recognition of his extensive work on the butterflies and moths of Brazil.

Mr. O. I. Snapp, Bureau of Entomology, was scheduled to attend the 46th annual meeting of the Georgia State Horticultural Society, September 6 and 7, at Cordele, Ga., and to discuss the plum curculio investigations being carried on by the Bureau.

Messrs. C. C. McDonnell, Chief, and Ira N. Neifert and W. H. Tonkin of the Federal Insecticide and Fungicide Laboratory, have been conducting field experiments in Maryland with different gases to control the insect pests that infest grains in storage and in transit.

Dr. L. O. Howard was scheduled to speak on "Warfare Against Insects" in a course of lectures on science to be given daily from July 10 to August 15 at the Horace Mann Auditorium, Teachers College, Columbia University, New York City. The lectures are given at 2:30 P. M.

A study of the natural control of the tent caterpillar of which there is a serious outbreak in the maritime provinces this year is marked by a conspicuous absence of parasites. In 1915 this insect was almost entirely killed out by a light frost and the parasites may have been killed out at the same time.

Mr. E. J. Newcomer reports that the efforts of the Bureau of Entomology in importing codling moth parasites from the East for establishment in orchards around Yakima, Wash., under way for the past two or three years, have been successful, in the case of one species at least, *Bassus carpocapsae*, which has been secured from band material collected last fall.

The scouting to determine the spread of the apple sucker in Nova Scotia was completed some time ago. As a result of this work it was found that the pest had spread into quite a large area, particularly in a southerly and southwesterly direction. The work was carried on in co-operation with the Nova Scotia Department of Agriculture.

The European corn borer scouting work was started in Canada on July 24th, but all the crews were not at work until August 1st. Five crews are now engaged in the scouting and up to August 5th, twenty-four townships were scouted, eleven of which were found infested. A total of 412 fields were examined, comprising about 1929 acres of corn.

Mr. J. C. M. Gardner is a Carnegie student and not a Rhodes Research Scholar as was stated in the August issue of this JOURNAL. Besides visiting Canada he spent six months in the United States and traveled from Washington to the Pacific Coast and back again, visiting field stations. He also investigated the gipsy moth and European corn borer work near Boston, and sailed for England on August 22.

During the latter part of August and the early part of September, Dr. A. C. Baker of the Bureau of Entomology made a trip through the northeastern part of the United States, observing insect conditions in the grape belt in western New York State and Ohio, and visiting the Bureau field stations at Sandusky, Ohio and Wallingford, Conn., and the Connecticut Agricultural Experiment Station.

Professor H. A. Ballou, Entomologist to the Imperial Department of Agriculture, located at Barbados, British West Indies, will move his office to the West Indian Agricultural College, St. Augustine, Trinidad. This has resulted from the amalgamation of the department of Agriculture and the Agricultural College. Professor Ballou will have charge of the entomological work in the College and the experimental work in the West Indian Islands, as heretofore.

Mr. W. R. Walton, Bureau of Entomology, in company with Mr. Arthur Gibson, Dominion Entomologist, and Doctors Craighead and Tothill, reached Fredericton on July 20, and proceeded to the head waters of the Cains River. On the 21st, they traveled by canoe to the mouth of the river where it unites with the Miramichi, a distance of about 70 miles, and saw much injury caused by the spruce bud worm.

Mr. L. S. McLaine, Chief of the Division of Foreign Pests Suppression, Canada, returned from the west on July 14th. During his journey eastwards he met and discussed with the various Provincial officials the proposed changes to the regulations under the Destructive Insect and Pest Act, and also visited the fumigation stations at North Portal, Sask., and Winnipeg, Man. Mr. McLaine left for a short visit to southern Ontario the latter part of July and returned on August 3d.

Arrangements have been made with the management of the *Dallas News* and *Dallas Journal* to broadcast from their radio station talks by F. C. Bishop of the Bureau of Entomology on insects and their control. It is planned to make these talks timely and presented in simple form so that they can be understood and utilized by all classes of people. There is a lively interest in the radio throughout north Texas, and this is especially apparent in the rural communities. It is believed that these talks will aid the farmers in combating insects which threaten their crops and also help disseminate information on those forms inimical to domestic animals and poultry. Considerable attention will be paid to disease bearing insects and household pests. The first talk of the series was broadcasted on September 5th, and it is planned to give out regularly two talks each week. The first was of an introductory nature entitled "Insects and Human Welfare." Some of those following deal with the cotton leaf worm, mosquitoes, the bollworm, the screw-worm, Argentine ant, and ox warble.

Dr. A. E. Cameron, professor of zoology in the University of Saskatchewan, has now definitely severed his connection with the Entomological Branch, Canada. Dr. Cameron became associated with the Branch in 1917 on the invitation of the late Dr. C. Gordon Hewitt, whom he followed as lecturer in economic zoology in Victoria University, Manchester, England. Dr. Cameron has continued to carry on the work of the Branch in Saskatchewan since his resignation in 1920 pending the appointment of a qualified entomologist.

The termite, *Coptotermes niger* Snyder, is causing serious damage to lead-covered cable at the locks of the Panama Canal. These termites work through the lead, often causing large openings, and then travel between the two wires of the Duplex cable. Since the space between these two wires is not ample, they eat away the insulation. Another termite, *Nasutitermes ephratae* Holmgren, is a very serious offender also; it does not care for lead but works havoc in rubber, cloth, and other insulation.

The following appointments in the Bureau of Entomology have been announced. Mr. Chester I. Bliss of Columbia University, field assistant grape insect work, Sandusky, Ohio; temporary appointments, L. P. O'Dowd, sugar cane insect investigations, southern Mississippi; E. F. Haden; H. C. Plummer, M. L. MacQueen, T. P. Weakley, W. B. Weakley, L. N. Judah, tobacco insects, Clarksville, Tenn.; Dr. Carroll G. Bull, W. C. Gideon, J. A. Welch, malaria mosquito work, Mound, La.; A. J. Chapman, Alex Clark, J. R. Cole, R. C. Dancy, S. B. Hendricks, R. L. Hester, E. E. Holley, J. E. Humphries, J. W. Ingram, I. T. Jones, W. H. May, A. L. Monroe, Wm. D. Reed, Paul D. Sanders, J. T. Wilson, T. L. Wilkerson, L. P. Hodges, H. C. Young, cotton boll weevil work, Tallulah, La.

The scouting work for the alfalfa weevil was started in southern Alberta on July 1st. Owing to the large amount of alfalfa being grown in this area it was decided to determine whether this pest had invaded the alfalfa growing districts. The work is being carried on by Messrs. C. W. Minue and J. Lowe, and is under the immediate supervision of Mr. H. L. Seamans of the Lethbridge Laboratory. Up to July 31st, 286 farms had been visited and 6700 acres of alfalfa were examined; 313 collections of insects were made in the fields and upon examination at the Lethbridge Laboratory, no sign of the alfalfa weevil was found.

One of the best peach crops ever produced in Georgia was harvested in 1922. The progress made in overcoming the heavy curculio infestation has been very gratifying. All varieties through to the close of the Elbertas have been unusually free from curculio larvae. Careful investigations of commercial orchards treated according to the advice of Department and State specialists showed that curculio damage was not greater than an average of one wormy peach in each ⅝-bushel basket. In these orchards dropped fruit had been picked up and destroyed and cultivation for the destruction of pupae had been practiced in addition to very thorough spraying. The San Jose scale appears to be on the increase in the Georgia peach belt.

Mr. J. E. Graf, entomologist in charge, field control, Mexican bean beetle, Bureau of Entomology, has just returned to Birmingham, Ala., after investigating the bean beetle in the Estancia Valley of New Mexico. He reports that the beetle has received a serious check owing to the shortage of moisture during the past winter and spring, which has occasioned a reduction in acreage from 90,000 to 20,000 acres

in the Valley. Distribution after hibernation follows prevailing winds down the canyon, but owing to the scarcity of food plants, beetles are becoming more widely separated than usual. Flights of one to two miles, several of which occur a day, are not uncommon. Since the average net return from an acre of beans is about $15.00, expensive control measures cannot be instituted.

Dr. J. M. Swaine, Chief of the Division of Forest Insects, Entomological Branch, Canadian Department of Agriculture, returned to Ottawa on August 2d, after spending some time in eastern Quebec and New Brunswick. Dr. Swaine reports an interesting situation in connection with the outbreak of the eastern spruce bark beetles of the Gaspé Peninsula. A considerable amount of the infested area was burnt over and some of the timber killed by fire in July, 1921. On this burn, all the large spruce which were scorched only at the base, are now attacked by the above insects, and this dying timber is drawing the infestation from the living timber for a long distance around the burned area. These trees are serving as traps and will be cut this coming winter.

Mr. Arthur Gibson, Dominion Entomologist, spent most of the week ending June 18th in western Ontario in connection with official matters. During this period the European Corn Borer Laboratory at Port Stanley, Ont., the Field Crop Insect Laboratory at Strathroy, Ont., and the Fruit Insect Laboratory at Vineland, Ont., were visited. On June 26 to 28, he attended the second annual convention of the Canadian Society of Technical Agriculturists held at Macdonald College, Que., having been elected a member of the Dominion Executive. Mr. Gibson was recently honoured by being elected an Honorary Member of the Quebec Society for the Protection of Plants. Mr. Gibson left Ottawa on July 16th for the maritime provinces, during his visit to the east he will investigate the work being carried on by various officers of the Branch in New Brunswick and Nova Scotia.

Mr. K. M. King, B.Sc., of Charlottesville, Va., was recently appointed Entomologist for Saskatchewan with headquarters at Saskatoon. The position in Saskatchewan has been vacant since the resignation of Dr. A. R. Cameron in 1920, owing to the fact that it has been impossible up to the present time to find a suitably trained man for the position. Mr. King received his training at the University of Washington and the Montana State College, and received his degree from the latter institution in 1920. Mr. King has had experience with grasshopppers and the pale western cutworm in Montana, which fits him particularly for his future work in Saskatchewan. Since April 1920, he has been engaged with the Bureau of Entomology working on insects affecting field crops. Mr. King served with the United States Army in France. He will report for duty in Saskatoon about the middle of August.

The following men have accepted temporary appointments at the Japanese Beetle Laboratory, Riverton, N. J., for this summer and have reported for duty: Prof. W. A. Price, of Purdue University; Dr. Henry Fox, of Mercer University; H. H. Pratt, a graduate of Rutgers College, and J. H. Painter, a graduate of the University of Maryland. There was received at the Japanese Beetle Laboratory earlier in the spring what is believed to have been one of the largest shipments of imported parasite material ever brought into this country from abroad. Something over a hundred thousand cocoons of a tachinid known to be parasitic on the Japanese beetle in Japan were sent to the laboratory by C. P. Clausen and J. L. King, who are stationed

in Japan and working upon Japanese beetle parasites there. A fairly large proportion of these cocoons were apparently in good condition upon their arrival at the laboratory and emergence has just commenced.

The Japanese beetle has been much more abundant during the present season than in any previous year and over a wider area. Serious damage has been caused by the immense numbers of the beetles to the foliage of many trees, especially fruit trees and certain varieties of shade trees. There has been important injury to early fruit, particularly early apples and early peaches. Recent visitors at the Japanese Beetle Laboratory, Riverton, N. J., include: Dr. E. D. Ball, Dr. L. O. Howard, Dr. A. L. Quaintance, and Dr. C. L. Marlatt from the U. S. Department. Other visitors include Dr. T. J. Headlee, State Entomologist of New Jersey, and Mr. H. B. Weiss of the State Department of Agriculture, New Jersey, and Prof. F. Rasmussen and Prof. J. G. Sanders of the Pennsylvania Department of Agriculture. A committee of the New Jersey State Board of Agriculture also recently spent part of a day at the Laboratory looking over the beetle situation.

Mr. R. Owen Wahl, Carnegie Student from South Africa, who spent the months from February to July in this country visiting field laboratories and experiment stations, in a letter to Doctor Howard written from Vancouver, B. C., July 21, on the eve of sailing for Australia, said: "Before leaving the continent, I would like to thank you, Doctor Quaintance, and all the host of entomologists I have met for their unfailing consideration and kindness to me. Always have I found the utmost hospitality and good fellowship and no one spared any trouble to make my stay pleasant as well as profitable If you have any means of conveying my sincere thanks to them I am sure you will do so. I am leaving the United States with great regret, but will always have the keenest interest in your wonderful country, and the thought of all the workers in entomology doing their bit will always be an inspiration to me."

Mr. G. A. Runner, in charge of the grape insect work for the Bureau of Entomology at the Federal laboratory at Sandusky, Ohio, reports severe injury from grape leafhoppers in vineyard sections of New York, Ohio, and Michigan, and that large numbers of grape growers have commenced spraying operations for control. In Ohio and Michigan the grape-berry moth has caused more than the usual amount of damage to the grape clusters by feeding on the stems or buds during the blossoming period. At Lawton, Mich., on June 8, Mr. Runner found cocoons of the grape-berry moth on the grape leaves. This shows an unusually early development of the larvae, as grapes were just out of bloom, and shows that early appearing larvae are able to complete fully their growth without entering the grape berries. At Paw Paw, Mich., bud clusters infested with the grape-blossom midge (*Contarinia johnsoni* Sling.) were observed on June 8. The insect had not been reported from that section previously.

The citrus black-fly, introduced into the Canal Zone from the West Indies, is rapidly spreading, according to Mr. James Zetek, who is in charge of the field station there. This pest is now well distributed for about twelve miles out from Panama City, all along the Canal Zone, and has been introduced in the interior at Aguadulce. Two entomogenous fungi, *Aschersonia aleyrodis* and *Aegerita webberi*, are following the black-fly, but are not sufficient to check it. Agriculture is still in its infancy in Panama so that practically no control or restrictive measures are being taken against

any pest. Mr. Zetek also reports the papaya fruit fly very abundant and well distributed wherever papayas are grown. In some of the papaya groves the damage due to this species amounts to 90 per cent. of the crop. In some parts of the interior of Panama it is impossible to grow papayas without having them infested, unless the very thick-fleshed varieties are grown. The picking and destroying of infested papayas, and allowing chickens to live in the grove, are the two most efficient control measures.

Mr. Harry Hargreaves, Government Entomologist of the British Protectorate of Uganda, Central Africa, spent several days in Washington recently visiting the Bureau of Entomology and acquainting himself with its work.

Mr. F. X. Williams, an entomologist of the Hawaiian Sugar Planters' Experiment Station, recently spent ten days in Washington on his way to northern South America where he will search for parasites of the sugar-cane wireworm in Hawaii.

Mr. G. S. Cotterell, a Carnegie scholar, has arrived in Washington and will spend about four months in the United States to familiarize himsel with economic entomology in this country. He is Assistant Government Entomologist, Gold Coast Colony, West Africa.

Prof. Alphonso Herrera, Director de Estudios Biologicos de Mejico, visited the Bureau of Entomology at different times during the latter part of August. Professor Herrera has been investigating the research work of the Government, but has been especially interested in entomology.

Mr. Faustino Q. Otanes, of the Bureau of Agriculture, Philippine Islands, visited the Bureau of Entomology and will spend several months in the United States, familiarizing himself with the work being carried out by the Bureau at its various field stations.

In the United States Bureau of Entomology, Dr. C. L. Marlatt, assistant chief, has been advanced to Associate Chief of the Bureau in Charge of Regulatory Work, and Dr. A. L. Quanitance, in charge of Fruit Insect Investigations, has been advanced to Associate Chief in Charge of Research Work.

Preliminary tests of the efficiency of the aeroplane in distributing calcium arsenate dust upon cotton fields for control of the boll weevil were conducted during the latter part of the month at Scott, Miss., under the direction of B. R. Coad, of the Bureau of Entomology. Mr. Coad reports a remarkable evenness of distribution of the poison by this method.

Notes on Medical Entomology

Dr. T. J. Headlee visited Providence, R. I., September 11-13 to give expert advice in mosquito eradication in connection with the local campaign there.

Dr. W. V. King of the Bureau of Entomology attented a conference at Hamilton, Mont., on July 27, in order to obtain information regarding spotted fever conditions.

Prof. W. A. Riley of the University of Minnesota, is a member of an expedition from the Johns Hopkins University to Porto Rico to investigate the hook worm disease.

Dr. C. L. A. Laveran, professor at the Pasteur Institute, Paris, and the discoverer of the malarial parasite in Algeria in 1880, died May 18, at the age of 77. Dr. Laveran received the Nobel prize for medicine in 1907.

A meeting was held recently at Harvard University, at which the subject under discussion was the killing of flies and mosquitoes. Sanitary experts, business men and the heads of women's and children's welfare organizations of the metropolitan district were present. J. Albert C. Nyhen, director of fly and mosquito suppression of the Brookline Board of Health, and Prof. G. C. Whipple, of the engineering department of Harvard University, called the meeting, at which Prof. Whipple presided. Its purposes were to consider action to be taken in a co-operative movement for the suppression of mosquitoes and flies in the metropolitan area and to call a later meeting to start a state-wide campaign. It is hoped that all insect nuisances affecting public health may be abolished and the movement will try to include the flea and the biting fly.

Apicultural Notes

The 42d annual convention of the Ontario Beekeepers' Association will be held at Toronto, December 6-8.

Kentucky has enacted a new foul brood law with Professor Harrison Garman in charge of its administration.

The annual meeting of the Georgia Beekeepers' Association was scheduled to be held at Hopkins, Ga., August 24-26.

Mr. George R. Vansell has been appointed by the University of California for the work in beekeeping at the University Farm, Davis, Cal.

The annual field day of the Eastern Massachusetts Society of Beekeepers was scheduled to be held at Boston, Saturday, August 19, with Dr. E. F. Phillips as the principal speaker.

A joint field meeting of the Pennsylvania State Beekeepers' Association and the Northern Pennsylvania Beekeepers' Association was announced to be held August 3, at the apiary of Harry Beaver, Troy, Pa.

According to *Gleanings in Bee Culture*, the committee in charge of the Miller Memorial Fund has decided to locate the Memorial Library devoted to apiculture, at the University of Wisconsin, Madison, Wis.

The Wisconsin Beekeepers' Field Meeting and Conference was held at Green Bay, Wis., August 7-11. Speakers from outside the State were Dr. E. F. Phillips, E. R. Root, George S. Demuth and C. P. Dedant.

The Empire State Federation of Beekeepers' Co-operative Association, Inc., formerly the New York State Association of Beekeepers' Societies, announced the holding of an annual picnic and summer meeting at the home apiary of N. L. Stevens, Venice Center, Cayuga County, N. Y., on August 4.

The Maryland State Beekeepers' Association met for an afternoon field meeting at the Bee Culture Laboratory of the Bureau of Entomology on July 29. A short program was arranged by the members of the Bureau staff and the visitors were shown

about the Laboratory. This is the forth year that this Association has arranged such a visit to the Laboratory.

Dr. E. F. Phillips, apiculturist of the Bureau of Entomology, attended the annual field meeting of the Empire State Federation of Beekeepers' Co-operative Associations held at Venice Center, N. Y., on August 4; the extension short course in beekeeping given at the University of Wisconsin, August 7-11, and the annual meeting of the Eastern Massachusetts Beekeepers' Association, to be held near Boston, Mass., on August 19. He also expected to attend the annual field meeting of the Massachusetts Society of Beekeepers, at North Andover, Mass., September 2.

Horticultural Inspection Notes

On August 8 a large number of members of the New Jersey Nurserymen's Association, together with visitors from the Pennsylvania Nurserymen's Association, visited the Japanese Beetle Laboratory at Riverton, N. J., for the purpose of obtaining first-hand information about the beetle situation and observing the experimental work under way. Members of the Pennsylvania Horticultural Society on their annual automobile tour also visited the Laboratory earlier in the month.

Messrs. E. J. Newcomer and W. D. Whitcomb were in attendance at the fifth annual meeting of the Northwestern Association of Horticulturists, Entomologists, and Plant Pathologists which convened at Yakima, Wash., July 24–26. Several sessions were devoted to the reading of papers and to discussions. Field trips were made to commercial orchards, potato fields, coldstorage and packing plants, and to the experimental orchard and laboratory of the Bureau of Entomology.

Mr. Curtis A. Benton, who has been in charge of the Federal Port Inspection work at New Orleans during the past year, resigned the first of September for the purpose of taking post-graduate work at the University of Illinois.

Messrs. R. Kent Beattie, David Lumsden, and J. M. R. Adams, Foreign Plant Quarantine Service, Federal Horticultural Board, devoted considerable time during the months of August and September to visiting various establishments which have received plants during the past year under special permit.

Mr. E. R. Sasscer, of the Plant Quarantine Inspection Service, Federal Horticultural Board, recently visited the ports on the Mexican border as well as the maritine ports on the Pacific coast for the purpose of interviewing the inspectors and the customs officials located at these ports of entry.

The Annual Letter of Information, giving notes on pests collected from imported plants and plant products by State and Federal Inspectors from January 1, 1921 to December 31, 1921 inclusive, was recently published. This letter is available to all inspectors engaged in examination of foreign plant material.

The conference held by the Federal Horticultural Board in Washington to consider the potato wart situation on August 22d, was attended by the following State officials: Mel T. Cook, New Jersey, N. J. Giddings, West Virginia, T. B. Symons and R. A. Jehle, Maryland, W. A. McCubbin, Pennsylvania, and L. M. Massey, New York.

The following interesting interceptions were recently made by Mr. George Compere of the California State Department of Agriculture, stationed at San Francisco: Maggots of the Mexican fruit fly, *Anastrepha ludens* Loew., in mangos from Mexico; maggots of the melon fly, *Bactrocera cucurbitae* Coq., in cucumbers from Hawaii; and *Lepidosaphes auriculata* Green, on croton from Hawaii.

Mr. Lee A. Strong, Chief, Bureau Plant Quarantine, of the State of California, left Sacramento September first for the purpose of studying the port inspection methods employed in New York, Boston, Philadelphia and Washington. Incidentally while in the East Mr. Strong visited the Japanese Beetle laboratory at Riverton, New Jersey, and the Bean Beetle laboratory at Birmingham, Alabama.

Mr. Max Kisliuk, Jr., recently forwarded to Washington a moth which had been collected by a steward of a ship arriving in Philadelphia from Hull, England. The moth in question was collected while the vessel was in mid-ocean and has been identified by Dr. Schaus as the lappet moth, *Gastropacha quercifolia* Linn. Although this insect is not looked upon as a pest in England, its food plants include apple, plum, pear, hawthorn, blackthorn, willow and sallow.

Mr. Max Kisliuk, Jr., in cooperation with the post office officials in Philadelphia, intercepted on August 28th a sample package of cotton seed which had been shipped from Brazil. On close examination the seed was found to be infested with the pink boll worm. To further illustrate the danger of importing injurious insects in foreign mail shipments, Mr. Harris Sargent, who is in charge of the Federal Inspection Work at Portland, Oregon, reports that recently a consignee brought to his office a package containing approximately two pounds of cotton which had been delivered by the post-man to the latter. The cotton in question was shipped from Peru.

The fifteen-car fumigation house at Laredo, Texas, was totally destroyed by fire on July 19th. The fire originated at the oil tanks owned by the Humble Oil Company, which were located nearby and rapidly spread to the fumigation house. In addition to the destruction of the fumigation house, one carload of cyanid, one carload of sulphuric acid, three hydrocyanic-acid gas generators, and necessary acid, and cyanid mixing tanks were destroyed. At the time of the fire there were two empty railroad cars in the fumigation house which were also destroyed. The loss is estimated at approximately $35,000. Steps were immediately taken to draw up plans and secure bids covering the erection of a new fumigation house at that point.

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Proceedings of the Seventh Annual Meeting of the Pacific Slope Branch of the American Association of Economic Entomologists

The Seventh annual meeting of the Pacific Slope Branch of the American Association of Economic Entomologists was held in room 103, Medical Building, University of Utah, Salt Lake City, Utah, July 22, 1922.

The meeting was called to order at 10:45 by Chairman A. L. Lovett, a brief business meeting was held, followed by the presentation of papers. The session closed at 3:00 P. M., with the election of officers and other unfinished business.

PART I. BUSINESS

The business session was called to order by Chairman A. L. Lovett at 10:45 A. M., July 22, 1922. The following were present:

L. O. Howard, Washington D. C.; Mrs. Roy E. Campbell, Alhambra, Calif.; Roy E. Campbell, Alhambra, Calif.; James C. Evenden, Coeur d'Alene, Idaho; C. F. Stahl, Riverside, Calif.; Robert K. Vickery, Saratoga, Calif.; Don B. Whelan, Boise, Idaho; Harold R. Hagan, Salt Lake City, Utah; E. L. Barrett, Bountiful, Utah; George I. Reeves, Salt Lake City, Utah; Ira M. Hawley, Logan, Utah; A. O. Larson, Alhambra, Calif.; E. P. VanDuzee, San Francisco, Calif.; Vasco M. Tanner, St. George, Utah; Wyatt W. Jones, Salt Lake City, Utah; George P. Englehardt, Brooklyn, N. Y.; George Bliss Engelhardt, Brooklyn, N. Y; Edgar McLedyard, Salt Lake City, Utah; C. P. Gillette, Ft. Collins, Colo.; and A. L. Lovett, Corvallis, Ore.

The following committees were named by the Chair: Nominating Committee: A. O. Larson, Chairman, Ira M. Hawley, Geo. I. Reeves; Membership: E. J. Newcomer, Chairman, Edwin C. Van Dyke, C. W. Creel; Auditing: Ira M. Hawley.

The report of the Secretary-Treasurer was then presented.

FINANCIAL STATEMENT

January 1, 1922			
	Amount on hand		$24.60
Jan. 27, 1922			
(1)	100 Large Envelopes	$2.31	
(2)	Mimeographed Letters	.85	
Feb. 25, 1922			
(3)	Affiliation Fee to A. A. A. S.	5.00	
June 17, 1922			
(4)	Buying, Printing & Mailing 100 Post Cards	3.02	
	Expenditures	$11.18	
June 17, 1922			
	Balance on hand		$13.42
	Amt. due from Am. Assn. Ec. Ent.		11.18

Following the presentation of papers, the closing business session was held. The nominating committee reported as follows:

Report of Nominating Committee:

We respectfully recommend the following as officers of this association for next year:

For Chairman H. J. Quayle, Riverside, California.

For Secretary-Treasurer E. O. Essig, Berkeley, California.

The report was duly adopted and the officers elected.

Dr. Hawley reporting on the audit of the Secretary-Treasurer report as O. K.

The Editorial Committee was appointed as follows: Chairman Harold R. Hagan, C. P. Gillette.

PART II. PAPERS

THE SUGAR-BEET ROOT-MAGGOTT (*TETANOPS ALDRICHI* HENDEL), A NEW PEST OF SUGAR-BEETS[1]

By I. M. HAWLEY

During July, 1920, fly larvae were found destroying many fields of sugar-beets near Amalga, Utah. Maggots collected at this time were reared by H. J. Pack, and the flies were later determined as *Tetanops aldrichi* Hendel of the family Ortalidae. The flies are about 6 mm. in length, glossy black, with a smoky patch on the costal margin of the wing about one-third of the distance from base to tip. Doctor Aldrich, after whom the insect was named, informed the writer in correspondence that flies of this species have been collected in the Province of Alberta,

[1]Contribution from the Entomological Department, Utah Agricultural College.

Canada, as well as at Burns, Oregon, and Moscow, Idaho, and that, as far as he knows, the larval stage had not been observed previously. The maggots also have been reported as causing considerable damage locally in Idaho by Doctor Titus and in Colorado by Mr. Maxson of the Great Western Sugar Company. With the exception of a possible infestation in Emery County, the destructive work of the insect in Utah appears to be restricted to a few townships in Cache County.

The maggots of *Tetanops* are of the typical dipterous type. They injure beets by feeding on the tap root. The area around the point of attack turns black and the surrounding soil is saturated by the leakage of beet sap. When the beets are small and feeding is just beginning, the roots are often entirely eaten thru. The first indication of the presence of the pests is the wilting of the plants. As feeding proceeds, these plants die and dry up and, by midsummer, fields will show many skips and bare spots. A. H. Bateman, a field man with the Amalgamated Sugar Company, states that in 1921 three hundred and forty acres were rotated because of this pest in the Lewiston District, Utah. He further reports that in 1921 there was an estimated loss of 924 tons in the infested area—about 21 per cent of the crop. In some places 50 to 75 per cent of the plants have been destroyed. Sixty-four maggots have been found around one plant, and beets surrounded by ten to thirty have not been uncommon. A single larva may destroy a beet seedling and apparently three or four are able to kill a beet one and one-half inches in diameter. The greatest damage occurs after thinning, during the last half of June.

The life-history of *Tetanops* has been under observation since July, 1921, when a study of the insect was first undertaken by H. J. Pack and the writer. At this time the maggots were nearly full grown, and in most cases had stopped feeding. They were in an inactive condition from one to six inches from their host and at a depth of one to three inches in the ground. As the summer progressed they moved deeper in the soil and when last examined in September they were found, head downward, at depths of four to thirteen inches. Hibernation must have occurred in the larval stage, for, when fields were first examined on May 15, 1922, about two-thirds were still maggots and one-third were in the pupal stage. Puparia were never deeper than three inches and more often they were just beneath the upper crust, showing that the maggots had migrated upward before they transformed. In fact, the larval tunnels were often found in the dirt. The average pupal period had been determined as fourteen days, and it would seem

therefore that pupation in 1922 occurred mostly during the second and third weeks of May.

By May 22 flies had emerged from pupae collected on May 15, and flies containing immature eggs were taken in the field on the same day. At this time, some beets were just appearing above ground, while others were not yet planted. By May 31, flies were very common in the fields and some contained mature eggs. On June 1 eggs were found in the soil of a cage in the laboratory, and they were obtained in a beet field on the following day. In loose ground the female crawls into crevices in the soil near a plant and deposits her eggs singly or in lots of two to forty. In compact soil the eggs will be found just beneath the surface of the ground, often in contact with the plant and rarely more than an inch from it. Most of the eggs were deposited during the week of June 1 to June 8, and by June 14 most of the eggs had hatched. The egg of *Tetanops* is 1.0 mm. in length, 0.25 mm. in width, slender, slightly curved, glossy white, unmarked, and much smaller at one end. Eggs have been found around nearly every beet plant in many of the fields examined. As high as forty were present around some plants. Eggs were also abundant around lamb's-quarters (*Chenopodium album*), red root (*Amaranthus retroflexus*), and the prostrate pigweed (*Amaranthus blitoides*).

By June 14 a few small larvae were beginning to feed on the tap roots, some as deep as three inches. The characteristic black feeding spot and the soil soaked with beet sap were already present, but wilting had not yet occurred. The pre-oviposition period was found to average about ten days and the egg stage covers five days, so it may be said that maggots will begin working on the beets approximately two weeks after the flies appear.

In nearly all cases where serious infestations of *Tetanops* have occurred the soil has been sandy or a sandy loam, tho they have been found sparingly in heavier soils. Maggots seem to thrive where the moisture content is very low. Flies will oviposit in dry sand, and the resistance that larvae have to lack of moisture was accidentally shown in another way. A flower-pot containing several dozen maggots was misplaced in the laboratory, and as a result was not watered for about two months. When the pot was examined later the maggots were healthy and crawling around in the dry sand. For some reason, these maggots were still in the larval stage on June 17, as the paper is being written. Another deviation from the above life-history has been found in our rearing work. In August, 1920, and again in 1921 a small number (perhaps 2 to 5 per cent) of the larvae in our cages have

transformed to flies. A few flies were also found in beet fields on August 6, 1921. It would seem that a small second brood of flies occurs in most years.

A beet field near Lewiston which had a very heavy infestation of maggots in 1921 was fall-plowed and seeded to wheat. This spring flies were abundant and a few eggs were found around weeds in the wheat but none around the grain itself. Eggs were also present near weeds in a potato field across the road. The nearest beet field was forty rods away, and here flies and eggs were unusually abundant. It would appear that flies sometimes migrate some distance to find suitable breeding places.

The control of *Tetanops* has received little attention up to the present time. Solutions of corrosive sublimate and other materials that may act as ovicides or larvicides were placed around plants on June 6, but the action of these cannot be observed for some time. It is hoped that when we know more about the insect some cultural practice may be found which will furnish an effective and cheap control.

Tetanops is apparently a native insect which has fed on weeds for many years and which is now adding the beet to its list of host plants. We rather feel that if early indications are fulfilled, it will this year take its place as one of the three most serious insect pests of beets in Cache Valley.

METALLIC MERCURY AS AN INSECTICIDE

By A. O. Larson,[1] *Assistant Entomologist, United States Department of Agriculture*

Dr. K. Kunhi Kannan of the Department of Agriculture of Mysore State, while visiting our laboratory in 1920, mentioned the fact that he had successfully prevented the hatching of Bruchid eggs in India by placing a small amount of metallic mercury in the container. While he was unable to give the identity of the Indian Bruchid, he said that it glued its eggs to the bean as does *B. quadrimaculatus*. He said that without the mercury appreciably decreasing in quantity, its presence in a container completely prevented the development of the eggs. He said that this action of mercury had been a tradition among his people.

As a result of this information three experiments with mercury and the eggs of *B. quadrimaculatus* were carried on at the same time, as follows:

[1]The first experiments were conducted by Perez Simmons, and the last cowpeas were dissected by A. H. Amis.

1. A pint of blackeyed cowpeas in a quart Mason jar were oviposited upon by a few females on September 21 and 22, 1920. On September 22 about a thimbleful of mercury was sprinkled into the jar and the lid screwed on. Shortly after a paraffined rubber ring was put on to exclude mites (*Pediculoides ventricosus*), but this was removed October 18. The beans were examined November 5. They were spread out and examined carefully with a reading glass. Infestation being light, only forty (40) eggs were found, and these were examined under the binocular. No embryos had developed. Marked preference was shown by the parent weevils for blackeyes with fewest wrinkles.

2. September 20, two thimblefuls of mercury were placed in a small vial with a hole in the cork and the vial placed upright in a pint of blackeyed cowpeas in a quart Mason jar. Twenty-three (23) *B. quadrimaculatus* were put in the same day. More weevils were put in September 22. Shortly after, a paraffined rubber ring was put on the jar; this was removed October 18. Examination of the beans was made on November 5, the beans being gone over carefully with a reading glass. One hundred thirty-five (135) eggs were picked out and examined under the binocular with the result that no embryos were found to have developed.

3. Twenty-two blackeyed cowpeas with thirty-nine (39) newly-deposited eggs were put in a small vial with one thimbleful of mercury. These eggs were laid September 20–23 and were put in the vial with the mercury on the 23rd. The vial then was sealed with a paraffined cork. Examination on November 5 showed that no embryos had developed, the eggshells being dry and empty without exception.

Small spots of black mold were found on the beans in all the containers. The paraffined rings and cork were thought advisable to exclude mites, but may have influenced the results. Later duplications of the above experiments, without using paraffin and rubber rings gave the same results, as far as the failure of the eggs to develop is concerned. In these no mold appeared.

On July 22, 1921, several weevils, *B. quadrimaculatus*, were put into a quart Mason jar of clean red ripper cowpeas. The next day, after oviposition had taken place freely, the eggs were examined with the aid of the binoculars, and all eggs that were not properly glued to the seed coat or that appeared to be imperfect in any way were discarded. One hundred (100) were placed in a vial, 3.2 x 10 cm. and an equal number was placed in a similar vial. These eggs were perfect as far as it was possible to determine. Into one vial was placed a little

vial 1.7 x 6.5 cm. containing about 1 cc. of mercury. The smaller vial containing a perforated cork was placed upright and the larger vials were set aside for observations.

In one week it was noted that eggs in the one vial were hatching, while those in the other were not. In another week it was observed that the larvae from the eggs in the one vial had almost all entered the cowpeas, while in the other vial not an egg had hatched.

On August 15th, after removing the vial of mercury, it was found that every egg that had been in the larger vial, along with the mercury, had shriveled up and appeared to have nothing inside of the chorion. These eggs were remarkable for the absence of all contents within. They were absolutely hollow. There was nothing to indicate that development had ever begun.

August 16th the cowpeas in the other vial were dissected and four live pupae, 74 live larvae and 8 dead larvae were found within. 86% of the eggs had actually produced larvae, and others showed embryonic development, while in the other vial there appeared to be absolutely no embryonic development. No mold appeared in either vial.

On July 25th several pairs of weevils, *B. quadrimaculatus*, were placed in a jar of red ripper cowpeas. These weevils oviposited freely, covering the cowpeas with varying numbers of eggs up to 15 or more, but averaging 8 or 9. Most of the weevils died before August 15th, and the greater number of eggs were laid during the early part of the period from July 25th to August 15th; in fact, many of the eggs had hatched and the larvae had entered before the latter date.

On August 15th two hundred of the cowpeas were counted out and placed in two vials 10 x 3.2 cm. Into the one vial was put a small vial (1.7 x 6.5) containing about one-half thimbleful of mercury. The cowpeas were arranged around the small vial which contained a perforated stopper. Tight stoppers were placed in both large vials, and they were placed side by side on a shelf for observation. For convenience they were labeled "mercury vial" and "check vial."

In a short time it appeared that weevils were at work in the "check vial," because borings and frass began to exude from the cowpeas. It soon became evident that the lack of proper ventilation in this vial was being felt by the weevils. They made openings through the seed coat, and three half-grown larvae left the cowpeas and died. By October 29th, mold began to appear in the vial. This mold developed so rapidly that it was feared that it would kill all the enclosed weevils; therefore on November 4th these cowpeas were placed in four clean dry vials similar to the original. These vials were laid down so that

the cowpeas could have an opportunity to dry and retard the development of the mold. On November 7th, adult weevils began to emerge. The vials were examined daily and all emerged adults were removed. On December 9th, after 101 adults had emerged, it was found that the vials were becoming infested with mites, *Pediculoides ventricosus*, which made it necessary to kill all within the vials. The cowpeas were then dissected and the contents tabulated.

Within the "mercury vial" there seemed to be no activity. No borings or frass exuded from the cowpeas; no larvae bored openings in the seed coats, and there was no evidence of the lack of proper ventilation. On October 6th, when it was thought that all the weevils were dead, seven cowpeas were dissected. The last one contained two half-grown larvae which were alive but were very inactive. The remaining 93 cowpeas were set aside for further observation. On December 9th a very small amount of mold appeared in the vial. By January 11th the mold had not increased to any appreciable extent, and no weevils had emerged; so the cowpeas were dissected and the contents tabulated. At this time all the weevils were dead.

				Adults			Larvae			
No. of Cowpeas	Treatment	No. of Eggs	No. Hatched	No. Emerged	No. unemerged	No. Pupae	No. full-grown	No. half-grown	No. fourth-grown	No. less than ¼ grown
100	Mercury	800	643	0	0	0	20	80	244	299
100	Check	920	814	101	79	61	29	82	154	307

The above table shows that in the mercury vial only 20 larvae became full-grown and only 80 more became half-grown, while in the check vial 101 adults emerged, 79 were ready to emerge, 61 had become pupae. While all weevils in the mercury vial died, and while only 101 emerged from the other vial, there is no doubt that most of the unemerged adults and pupae, and many of the larvae from the check vial would have emerged if the mites had not made it necessary to kill them.

In the foregoing experiments the presence of the mercury was the only thing that could possibly have caused the eggs and larvae to fail to develop. Only in one case was the mercury in contact with cowpeas, and then it was not in contact with the eggs. The mercury did not seem to diminish in amount, and as Dr. Kennan said, "It could be used over and over again with no apparent loss."

While the foregoing may not be of practical use in warehouses because of the initial cost of the mercury, it is of scientific interest and

may be put to use as an economical means of combating other insects. The writer has not had an opportunity to try it against clothes moths, but he can see no reason why a vial of mercury in a trunk or closet would not be effective in preventing the hatching of the moths' eggs. If later investigation shows that it will prevent the hatching of these eggs, it would be an economical and convenient method of control, because the initial cost of the mercury would be little, and it would require practically no attention after being placed in the desired location.[2]

PEACH TWIG-BORER EXPERIMENTS IN CALIFORNIA

(A Preliminary Report)

By W. P. DURUZ, *Pomology Division, University of California*

The peach twig-borer (*Anarsia lineatella* Zeller) or peach worm, as it is also known, has again become a very serious pest in California. The loss in shipping and canning fruits in 1920 and 1921, due to the damage of this caterpillar, was estimated at between 20 and 60 per cent of the crop.

Twenty years ago Professor W. T. Clarke[1], of the University of California, reported the results of careful experiments conducted in Placer County and recommended spraying with a lime-sulphur-salt mixture at the time the trees begin to bloom. This advice was accepted and fruit growers reported good control. Thus, spraying with lime-sulphur at the time the buds swell became the standard practice in California, for preventing "wormy fruit."

During the last three years, however, it has been observed that lime-sulphur sprays at this time did not free an orchard of infestation, and the loss caused by this insect became of great concern. Entomologists were not able to remedy the situation because of the lack of experimental work, also on account of the fact that the life history of the insect was in doubt. The effectiveness of present-day spray materials was also an unknown factor that had to be tested.

The great need for more facts was apparent; therefore Professor E. O. Essig and the writer outlined a project with a view of obtaining

[2]The only reference of which the writer has any knowledge is "Mercury as an Insecticide" (abstract) by K. Kunhi Kannan, in the report of the proceedings of the third entomological meeting, held at Pusa, Feb. 3 to 15, 1919, edited by T. B. Fletcher (Entomological Meeting, Pusa, Report of Proceedings, 1919, Volume 2, Pages 761-762.) The writer has not had an opportunity to see this article.

[1]Clarke, W. T., "The Peach Worm," California Experiment Station Bulletin No. 114, 1902.

information on the life history of the peach twig-borer and particularly how to satisfactorily control it.

The following questions required solution:—

1. Does lime-sulphur spray effectively control the peach twig-borer?

2. What are the relative values of lime-sulphur, its substitutes and other spray materials now in use?

3. What is the best time to apply the sprays?

4. What is the life history of the insect? Is there a second generation or only one irregular brood?

Spraying Experiments

The work was begun in the fall of 1920. Various orchards were inspected with the view of securing heavily infested trees for the purposes of the investigation. About 600 two-year-old almond seedlings at the University Farm, at Davis, were selected for the experiment. Mr. C. D. Gregory, of Winters, kindly volunteered the use of his apricot orchard, while Mr. J. Caughy of Vacaville offered 900 plum trees for spraying tests.

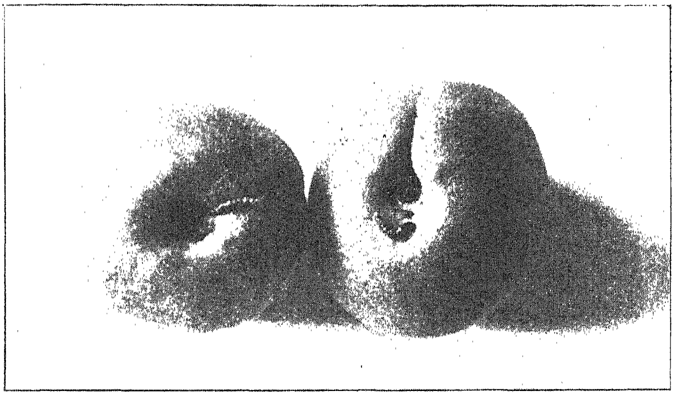
Various spray materials that have been recommended for control of the peach twig-borer were applied to the almond seedlings at Davis at three different stages, in order to determine the proper time of spraying. The experiments at Winters and Vacaville were planned to test the relative values of liquid lime-sulphur and dry lime-sulphur.

Table I shows the results of the 1921 experiments at Davis. Results of the Winters and Vacaville experiments are similar.

It will be noted from the data that nicotine sulphate and zinc arsenite gave excellent control when applied as the buds were swelling and at full bloom. Lime-sulphur controlled the insect only partially, while the lime-sulphur substitutes and the oil sprays were not effective.

The results of experiments in 1921 were used as a basis for more extensive experiments in 1922. Growers in different parts of the state became eager to test suggested remedies and cooperators were secured in Placer, Solano, and Yolo Counties. Professor Essig and the writer outlined and supervised these experiments. In addition to these numerous test plots, the writer, conducted experiments again on the almond seedlings at the University Farm, at Davis.

It is too early to report the results of all the 1922 experiments. In most of the orchards the twig injury caused by the first generation of larvae has not been enough to afford conclusive counts. The almond seedlings are the only ones that showed evidence of injury and counts



Injury to apricot fruit caused by larvae. Attack is usually made at the stem end of the fruit.

Twig of almond, showing characteristic wilting caused by boring of larvae of peach twig-borer.

were made of these tests. The effectiveness of different sprays on the larvae in these trees is shown in Table 2. A summary of two years work on the young almond seedlings is shown in Table 3.

TABLE 1. SUMMARY OF SPRAY APPLICATION FOR CONTROL OF PEACH TWIG-BORER ON ALMOND SEEDLINGS, UNIVERSITY FARM, DAVIS, CALIF., 1921.

Row No.	Date of Application 1921	Material and Type of Application	Dilution	No. of Trees Sprayed	No. of Larvae Found	% of Infestation	% Control
		TREES DORMANT					
10	1/31	Lime-Sulfur "Rex"	1 in 10	18	4	4.4	95.6
2 plus ½ of 4	1/31	Crude Oil Emulsion	5%	6	28	93.0	7.0
5	1/31	Distillate "	5%	16	132	165.0	−65.0
8	2/5	Spra-Mulsion	1–16	30	158	105.0	−5.0
		BUDS SWELLING					
11	2/9	Lime-Sulfur "Rex"	1 in 10	15	20	26–⅔	73–⅓
13	2/9	Spra-Mulsion	1–16	16	100	110.0	−10
17	2/9	Nicotine Sulphate (Hard Soap 3 lbs.)	¾ pt. to 100 gals.	15	2	2.5	97.5
19	2/11	B. T. S.	12–50	14	9	12.0	88.0
½ of 4	2/9	Crude Oil Emulsion	5%	6	13	43.0	47.0
7	2/9	Distillate Emulsion	5%	11	90	163	−63
		FULL BLOOM					
20	2/19	Lime-Sulfur "Rex"	1 in 10	15	16	21	79
22	2/22	Dry Lime-Sulfur	12–50	14	26	37	63
23	2/19	Spra-Mulsion	1–16	14	53	76.	24
26	2/22	Zinc Arsenite	2–100	13	0	0	100
28	2/19	Nicotine Sulphate (Hard Soap 3 lbs.)	¾ pt. to 100 gals.	14	0	0	100
29	2/19	B. T. S.	12–50	15	41	55	45
7	2/19	Distillate Emulsion	5%	13	56	86	14
Unsprayed Trees				304	1395	100	0
Average per unsprayed tree					5		

Note: 5 larvae per tree were taken as a basis in calculating per cent of infestation. The minus quantities are explained bythe more heavy infestations of the trees which are on the east side of orchard.

TABLE 2. PEACH TWIG-BORER CONTROL EXPERIMENTS, UNIVERSITY FARM, DAVIS, CALIF., 1922.

Row No.	Date of Application 1922	Material and Type of Application	Dilution	No. of Trees	No. of Larvae found	% of Infestation	% of Control.
		TREES DORMANT					
3	1/5	Sulco V-B	1 in 25	8	2	6.66	93.33
4	1/5	Sulco V-B (Nicotine sulphate	1–25 ¾ pt. – 100 gals.	12	16	43.33	56.66
6	1/3	Dry lime-sulphur (S–W)	12–50	20	45	75	25
7	1/3	Miscible Oil (Spra-Mulsion)	1–16	24	33	45.8	54.2
8	1/5	Liquid lime-sulphur ("Rex")	1 in 10	29	16	19.5	80.5
9	1/3	Nicotine sulphate plus Soap	¾ pt. – 100 gals. 3 lbs.	17	15	29.4	70.6
11	1/5	Miscible oil (Zeno)	1–16	18	73	135	−35
12	2/3	Lime-sulphur 1 in 10 plus Arsenate of lead,	1 in 10 4–100	17	16	31.4	68.6
13	2/3	Arsenate of Lead Casein spreader	4-100 ¾ lb.–100	18	30	55.5	44.5
14	2/6	Zinc Arsenite Casein spreader	2–100 ¾ lb.–100	16	31	64.6	35.4
		BUDS SWELLING					
16	2/11	Sulco V-B	1 in 25	8	16	66.66	33. 33
17	2/11	Sulco V-B Nicotine suphate	1 in 25 ¾ pt.–100 gals.	8	13	54	46
18	2/11	Dry lime-sulphur (S-W)	12–50	8	14	58.33	41.66
19	2/11	Miscible Oil (Spray-Mulsion)	1–16	7	12	57	43
21	2/11	Liquid lime-sulphur ("Rex")	1 in 10	7	0	0.	100

TABLE 2 (CONTINUED)

Row No.	Date of Application 1922	Material and Type of Application	Dilution	No. of Trees	No. of Larvae found.	% of Infestation	% of Control
22	2/11	Nicotine sulphate plus Soap	¾ pt.-100 gals. 3 lb.	7	1	4.7	95.5
23	2/14	Lime-Sulphur, plus Arsenate of Lead powder	1 in 10 4-100	7	2	9.4	80.6
24	2/18	Zinc Arsenite Casein	2-100 ¾-100	8	38	158	-58
26	2/18	Arsenate of Lead, powdered, Casein	4-100 ¾-100	8	0	0	100
29	2/4	Bordeaux Mixture, plus Lead Arsenate Powder (neutral)	4-5-50 8-200	7	5	23.8	76.2
		FULL BLOOM					
16	3/5 (pink	Sulco V-B	1 in 25	8	3	12.5	87.5
17	3/5 stage)	Sulco V-B Nicotine Sulphate	1-25 ¾ pt.-100	8	4	16.66	83.33
18	3/13	Dry lime-sulphur (S-W)	12-50 gals.	8	3	12.5	77.5
19	3/5 (pink stage)	Miscible Oil (Spra -Mulsion)	1-16	8	13	54	46
21	3/13 " "	Liquid Lime-sulphur ("Rex")	1 in 10	8	3	12.5	87.5
22	3/13 " "	Nicotine sulphate plus Soap	¾ pt.-100 gals. 3 lbs.	8	0	0	100
23	3/13 " "	Lime-sulphur "Rex" plus Arsenate of Lead powder	1 in 10 3-100	8	1	4.1	95.9
24	3/14 " "	Zinc Arsenite, powdered plus Casein	2-100 ¾-100	7	2	9.4	80.7
26	3/14 " "	Arsenate of lead, powdered, Casein	4-100 ¾-100	8	0	0	100
27	3/20	Nicodust	5%	8	34	141.7	-41.7
27	3/16	Magnesium Arsenate Casein	3-100 ¾ lb.-100	8	4	16.66	83.33
28	3/21	(Dry Arsenate of Lead Powdered Hydrated lime,	10 lbs. 30 lbs.	8	16	66.66	33.33
29	3/16	Bordeaux Mixture, Lead Arsenate powder (neutral)	4-5-50 8-200	7	10	47.6	52.4
Unsprayed trees,				137	367	100	0
Average per unsprayed tree					3		

Note: Three larvae per tree were taken as a basis in calculating per cent of infestation. Rains occurred on the following dates: 2/9, 2/10, 2/18, 2/19 and 2/20. First bloom of Almonds recorded March 1.

TABLE 3. PEACH TWIG-BORER CONTROL EXPERIMENTS, UNIVERSITY FARM, DAVIS, SUMMARY OF RESULTS, 1921-1922

Material and Type of Application	Percent Control 1921	Percent Control 1922	Average Percent Control
TREES DORMANT			
Liquid Lime-sulphur	95.6	80.5	88.0
Dry Lime-Sulphur	—	25.	25.0
Nicotine sulphate	97.5	70.6	84.0
Lime-sulphur, plus Arsenate of Lead	—	68.6	68.6
BUDS SWELLING			
Liquid lime-sulphur ("Rex")	73.3	100	86.6
Dry lime-sulphur	—	41.66	41.66
Spra-Mulsion	-10	43	16.
Nicotine sulphate	97.5	95.5	96.4
Arsenate of lead	—	100	100
Lime sulphur, plus Arsenate of lead	—	80.6	80.6
FULL BLOOM			
Liquid Lime-sulphur	79	87.5	83.2
Dry Lime -sulphur	63	77.5	70.2
Spra-Mulsion	24	46	35.0
Zinc arsenite	100	80.8	90.4
Nicotine sulphate	100	100	100
Arsenate of lead	—	100	100
Lime sulphur, plus Arsenate of lead	—	95.9	95.9

Referring to these tables, it will be observed that liquid lime-sulphur ("Rex") has given an average control of 88 per cent, 86.6 perc ent and 83.2 per cent at the three different stages. The addition of arsenate of lead increased the efficiency of lime-sulphur, in the full bloom spray. The arsenicals also were highly efficient in controlling this insect, especially when spraying was done during the blooming period; when applied earlier the rains washed them off before the caterpillars emerged. Nicotine sulphate has given a higher average control than any other spray tested. It is most effective during full bloom, however.

Life History Experiments

Evidences of a Second Generation. As has been previously stated, there have been conflicting theories regarding the life history of the peach twig-borer. Evidence is here presented to prove the existence of a distinct second generation, rather than one irregular brood.

The writer has followed closely the activities of the insect at Davis and these observations agree closely with those of Clarke made in Placer County in 1902. In order to prove that these observations were not those of only a few chance individuals, careful counts were made on each of 562 almond seedlings. The infested shoots were counted first between April 1 and 21, in comparing the effectiveness of the spray treatments already discussed. A second count was made between June 10 and 13.

Considering only the unsprayed check trees (numbering 304), there was an average of five larvae per tree at the first count. After April 21, there was no indication of an irregular infestation; all the larvae had pupated and there were no "stragglers." On June 8th large numbers of larvae were again noticed attacking the twigs on these trees. The second count was then made over the entire orchard, and a tremendous increase in number of larvae was found. There was an average of 12.5 larvae per tree at this time, showing an increase of 150 per cent in approximately one month. What is more significant is the fact that the sprayed trees, some of which showed no infestation in the first count, had the same average number per tree as the unsprayed trees. The increase in number and spread of the attack is attributed to egg laying and the flight of the moths. This is conclusive proof of the existence of a definite second generation. (The writer believes from his general observations that there is a third distinct generation also, but has not had opportunity to collect positive data.)

Conclusions

The results of two years investigation are not conclusive enough to warrant definite recommendations. Some very good "leads" have been

obtained, however. Lime-sulphur alone can not be regarded as a satisfactory remedy. The addition of arsenate of lead (neutral or basic) or nicotine sulphate to lime-sulphur, and this mixture applied as near the pink stage as possible is considered to be the best control for the peach twig-borer at the present time. If lime-sulphur spraying is not necessary for fungous diseases, nicotine sulphate sprayed at blooming time is recommended.

On account of the fact that there is a second generation, one spraying may not be sufficient. If complete control is not secured in a given district, the flight of surviving moths may scatter and multiply the infestation and "wormy fruit" will be the result. A spray applied the middle of May will probably reduce the fruit damage. The writer is testing the effectiveness of nicotine sulphate and arsenate of lead against the second generation of larvae and will be able to report results at the end of this season.

RESISTANCE OF CERTAIN SCALE INSECTS IN CERTAIN LOCALITIES TO HYDROCYANIC ACID FUMIGATION

By H. J. Quayle, *Citrus Experiment Station, Riverside, California*

In 1915 my attention was called to the unsatisfactory results of fumigation for the citrus red scale, *Chrysomphalus aurantii* Mask., that had been obtained in the vicinity of Corona, California. The red scale was very abundant in several groves in spite of the fact that the trees had been fumigated not only regularly in the fall but the more severely infested trees had been fumigated also in the spring. This condition is known to have prevailed for some years previous to 1915 and still prevails.

Ordinarily, the so-called 100- or 110-percent schedule of dosage is effective in controlling the red scale, but this schedule was considerably increased in the commercial fumigation work in the Corona district with the result as indicated above. In our experimental fumigation work there since 1915, dosages varying from 100 to 200 per cent for the regular period of 45 to 50 minutes, and dosages of from 75 to 100 per cent repeated at the end of the regular period, were given with unsatisfactory results. This experience, together with that of several different commercial firms, led us to suspect that the red scale is actually more difficult to kill in that district, rather than to ascribe the poor

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results to insufficient dosage, leaky tents, or lack of attention to the details of the work.

The time and place may very materially affect the results of fumigation, hence in any comparative work it is necessary to eliminate these two variable factors. This was done in the case in question by taking infested fruits from two localities and fumigating them under the same tent in a third locality. The fruits infested with red scale were picked from two localities on the same day, or from one of the localities on the day following. They were placed in the same basket, or two baskets were placed together under the tent, in order to guard against variation in gas concentration in different parts of the tent. Different series of such tests have been made repeatedly since 1915 under tents over "form trees," under tents in experimental fumigation work in the field, and under tents operated in commercial fumigation practice. Since 1915 it has been determined that the red scale in certain districts in Orange County manifests the same apparent resistance to hydrocyanic acid.

In the comparative tests reported below the dosage was varied considerably, but in all cases the scales from the different localities were under essentially identical conditions.

The summary results of a few representative tests are given below in table 1.

TABLE 1. THE EFFECT OF FUMIGATION ON RED SCALE FROM DIFFERENT LOCALITIES

Locality	No. of scales fumigated	No of scales alive	Percentage of scales alive
	SERIES I		
Orange	6,076	35	0.57
Corona	10,176	455	4.47
	SERIES II		
La Habra	1,388	6	0.43
Corona	1,430	280	19.58
	SERIES III		
Riverside	1,386	1	0.07
Corona	1,773	12	0.67
	SERIES IV		
Redlands	2,300	6	.26
Highgrove	2,700	49	1.81
Corona	4,300	173	4.02
	SERIES V		
La Habra	1,500	60	4.00
Corona	1,900	388	20.40

The fact that we have evidence extending over a period of seven years of exceptional resistance in the red scale at Corona, and in a district in Orange County extending over four or five years, would indicate that it is not necessarily a seasonal condition. If it is a case of acquired immunity and the factor of resistance is hereditary, it is necessary that this factor be transmitted through two or three generations of scales since this number intervenes between fumigations. We have some evidence to indicate that the individuals that are alive after

one fumigation are more resistant to a second fumigation than individuals which have not been previously fumigated. Also, that the greatest resistance is shown by scales on trees that have been fumigated regularly, once, or even twice, a year. More satisfactory fumigation results have often been secured on trees that have not been fumigated for two or three years than on trees that have been regularly fumigated where a certain number of the scale escaped being killed.

The variable factors of time and place affecting fumigation results have to do chiefly with meteorological conditions. There is also a variation in the condition of the tree itself, but this may be independent of the time or locality. Differences in the amount of foliage on the tree may influence fumigation results. Foliage absorbs hydrocyanic acid, and the more foliage there is present the more HCN will be absorbed and the less, apparently, will be left in the atmosphere to kill the insects on the exterior of the tree.

A series of tests were made to determine the relation of the foliage to the dosage. An ordinary orange tree with a medium amount of foliage was covered with a tent, and alongside this tree a wooden framework was constructed to support a tent, which enclosed a space identical in form and size with the orange tree. Lemons infested with red scale were placed in the same relative position under each tent. The tents were frequently interchanged to overcome tent variation. The dosage was varied, but was always the same under both tents in any given test. These tests showed that the proportion of scales killed was approximately 5½ per cent greater under the tent that contained no tree or foliage.

It has been noted in the field that on the heavy foliage-Lisbon type of lemon tree, scales are more likely to survive a fumigation than scales on trees with sparse foliage. Scales are much more difficult to kill on the fruit than on the twigs or leaves. Likewise, they are more difficult to kill on vigorous and thrifty leaves, and on vigorous shoots such as suckers, than on less thrifty leaves and twigs. This difference in resistance on different parts of the tree, or between two trees of different vigor, seems to be related to the food supply of the scale. If a particular locality had a monoply on the vigorous trees, the resistance of the insects might be explained on this basis, but the red scale is more difficult to kill on unhealthy trees in the areas where it shows exceptional resistance, than on healthy trees in other localities. The tree may constitute one of the variable factors in fumigation results, but that scale resistance is not entirely determined by the tree, is shown by the tests given. Here the resistance persisted after the scale-infested fruit was removed from the tree and fumigated in a different locality.

Certain stages of the red scale show more resistance to HCN gas than others. The molting period, particularly the second molt, and the adult or young-producing period, are the two most resistant stages, and of these two, the molting stage is the more resistant.

Among the variable meteorological conditions, humidity and wind are important, as affecting the results of fumigation. The ordinary canvas tenting material varies greatly in gas-holding capacity according to the dryness of the cloth, which is dependent upon the amount of humidity in the atmosphere, and also, varies according to the movement of the atmosphere. By means of a gas-tight tent we have been able to overcome the effect of humidity on the tent, and have eliminated tent leakage, the most variable factor in fumigation work. By the use of a gas-tight tent in different localities, further proof of exceptional scale resistance in certain localities has been secured.

In the case of the red scale at Corona, definite proof of resistance was lacking until comparative tests were made in which the variable factors of time and place were eliminated. At this time, however, after seven years' experience, observation of experimental and commercial work in the field is sufficient to establish the fact of resistance.

In 1915 our attention was also called to the difficulty of killing the black scale in the vicinity of Charter Oak, California.

Because the black scale does not infest the fruit (at least to any considerable extent) it has not been possible to carry out comparative fumigation tests on it from two or more localities at the same time, and in the same tent, as with the red scale. Infested twigs can be collected from different localities, however, although drying interferes with the results and is difficult to overcome. Our experimental fumigation work, as well as commercial work in the Charter Oak district for the past six years, furnishes ample proof that the black scale is much more difficult to kill with HCN gas there than in most other localities. In general, the black scale is most susceptible to HCN gas when it is small. When it reaches the mature stage fumigation results are much less satisfactory. In the Charter Oak district, however, with dosages greatly in excess of that ordinarily necessary to secure a 100 per cent kill, small scales in considerable numbers will come through the fumigation unharmed. In most other localities 25 per cent less gas would insure very satisfactory results on similar small scales.

There are thus two localities where it seems well established that the red scale is very resistant to hydrocyanic acid gas, and one locality where the black scale is specially resistant. In these localities these scales are

not immune to hydrocyanic acid, but the dosage required for satisfactory results is so large that effective fumigation is unsafe for the tree except under the most favorable conditions.

FACTS CONCERNING MIGRATION OF BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER) IN SACRAMENTO VALLEY OF CALIFORNIA

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I. INTRODUCTION

According to Ball (1) the beet leafhopper (*Eutettix tenella* Baker) is not found, except in periods of abundance, in the inland regions north of Sacramento. Ball (1) reports that during the serious outbreaks of curly leaf (curly top or blight) in 1914, considerable damage to the beet crops occurred at Hamilton City. After several years of idleness the sugar factory at Hamilton City resumed operations during 1918. This sugar mill was closed after the 1918 outbreak of curly leaf and since then has not operated.

II. CURLY LEAF

We (2) have published the results of our investigations conducted in the Sacramento Valley during 1918. In the beet fields near Hamilton City, not a single beet leafhopper was captured on June 6, and no blighted beets were found. Spring brood adults, however, were taken on garden beets at Marysville on June 2, but 5% of these beets were diseased, indicating an earlier invasion of the pest. A trip was taken into the Sacramento Valley on August 19–25, and from 66–86% of the sugar beets showed curly leaf symptoms, in the vicinity of Hamilton City. In the southern part of the valley from 36–86% of the beets were blighted.

During 1919, at least one or two trips per month were taken to all of the beet centers in the Sacramento Valley during the beet season. The first beet leafhopper was captured on Silverscale or Fog Weed (*Atriplex expansa*) near Woodland on May 27, but no curly leaf was found in the late planted beet fields. The average percentages of curly leaf in the various beet districts developed as follows during the past season.

	West Sacramento	Woodland	Knights Landing	Meridian
	%	%	%	%
April 27	0			
May 27	0	0	0	
June 16		5	8	
June 22		6	22	68
July 19	74	31.5	72	74
August 30	100	79	100	96

In the Sacramento Valley beets are planted from February to May and records of curly leaf were obtained during 1920 with reference to the time of planting. Five fields were selected in the Meridian beet districts and the percentage of curly leaf in each field was determined twice per month. Spring brood adults were rarely captured in the Meridian beet fields on May 27, and at Davis about 40 miles south on May 26. The dates of planting, number of irrigations, percentage of curly leaf and yield per acre are indicated in table 1.

TABLE 1. PERCENTAGES OF CURLY LEAF AND YIELD PER ACRE IN MERIDIAN BEET FIELDS DURING 1920.

Field	Number of acres	Dates of p anting	Number of irrigations	Percentages of curly leaf 5/27	7/1	7/12	7/20	8/9	8/26	Tons per acre
1	256	Feb. 14	*3	--	12	20	26	62	84	8.3
2	37	Feb. 16	2	--	14	28	54	88	98	5.37
3	47	Mar. 6	2	--	4	14	16	48		10.2
4	62	Mar. 14	2	--	14	32	52	92	96	4.6
5	35	Apr. 2	1	--	14	30	56	1 0	100	2.7

-- = less than 1% curly leaf. *=1 pre-irrigation, 2 summer irrigations.

It is evident from table 1, that the lowest tonnage was obtained in the April planted beet field.

During 1921, however, an earlier invasion of the beet leafhopper in the Sacramento Valley occurred. Two spring brood adults were captured on April 15, in half an hour at sunset in a beet field planted early in March at Woodland. No blighted beets were found. The leafhopper was not taken in the Meridian beet fields, about 30 miles north of Woodland on April 16 nor on April 30, when further investigations were discontinued.

During 1918–1920, the first appearance of curly leaf in the Sacramento Valley was about a month later than in the northern portion of the San Joaquin Valley due to a later invasion of the pest. On July 1, 1920, 14% of the March and April planted beet fields (Table 1, fields 4, 5) were blighted in the Meridian district of the Sacramento Valley compared with 94–100% at Union Island and Lathrop in the northern part of the San Joaquin Valley. It is evident that such factors should have a direct bearing on the average tons per acre h rvested.

III. Average Tons Per Acre in Sacramento and San Joaquin Valleys

During the past four outbreaks of the beet leafhopper the average tons per acre harvested in the Sacramento Valley and northern part of the San Joaquin Valley was as follows:

	Sacramento Valley		San Joaquin Valley
1918	8.49		5.58
1919	6.02		3.46
1920	6.92		5.12
1921	6.72		4.86
	7.02	Average	4.96

The average tons per acre would be lower if the acres abandoned on account of curly leaf were to be taken into consideration.

It is evident that the lowest average tonnage per acre was obtained during 1919 when the beet leafhoppers reached their maximum in numbers. Again in 1921, the average tons per acre was lower than in 1918 and 1920. In California general outbreaks of curly leaf occurred during the following years: 1899–1900; 1905; 1913–1914; 1918–1919–1920–1921.[c] It is evident that with the exception of 1905, and 1918–1921, the outbreaks of curly leaf occurred in two successive years, with the drop in tonnage due to the disease greater in the second year. During the four successive years of curly leaf, the drop in tonnage due to the disease was greater in the second and fourth years and it appears, seemingly, that a double two year outbreak of the blight has occurred.

During the three year interval between the 1913–1914 and 1918–1921 outbreaks of curly leaf, the average tons per acre in the Sacramento Valley and northern part of the San Joaquin Valley was as follows:

	Sacramento Valley		San Joaquin Valley
1915	9.17		7.75
1916	10.65		8.49
1917	9.76		6.73
	9.94	Average	7.29

IV. Spring Migration

We (3) have published the results of our investigations concerning a spring migration of the beet leafhopper into the Sacramento Valley. The evidence for a spring migration during 1918–1920, is associated with the fact that the first brood adults did not invade the cultivated area after the pasture vegetation became dry on the foothills and again, no specimens were found wintering over on the foothills during 1920–1921.

V. Autumn and Winter Investigations

Cultivated Area.—An attempt was made to determine whether an autumn dispersion to the foothills of the Sacramento Valley occurred. After the beets were harvested, the leafhoppers were found on saltbushes, pigweeds and other green plants during October 1920. During November and December the hoppers became fewer on green vegetation growing on the valley floor. The last record of the dark winter adults in the cultivated area was obtained at Clarksburg on January 6, 1921, when eight specimens were taken on a few beets still remaining in a field after the crop had been harvested.

Foothills of Coast Range.—The most intensive investigation was conducted during the autumn and winter, on the barren foothills of the Coast Range and Marysville Buttes covered with the most favorable winter host plant, namely, the Red Stem Filaree (*Erodium cicutarium*). No dark winter adults were found on the foothills which had not been cultivated. On the cultivated hills west of Yolo, two beet leafhoppers were captured on November 3, on a small patch of Red Stem Filaree growing in the vicinity of a watering trough, before the pasture vegetation had germinated. Specimens were also taken on weeds growing on the cultivated hills and on oleander. There was very little green vegetation available for the insects to feed on. After the pasture vegetation had germinated, a few adults were again taken on Red Stem Filaree at sunset on November 28, and a half dozen males on oleander. A trip was taken to the same locality on December 2, and a single male was found on Red Stem Filaree, but none on oleander.

The eastern foothills of the Coast Range bordering the western side of the Sacramento Valley were examined several times from October 1920 to February 1921. The beet leafhopper was not found wintering over on the uncultivated, barren foothills. The location of the foothills examined from north to south with reference to distances and directions of the nearest towns follow:

25 miles west of Cottonwood.
Vicinity of Newville and Paskenta.
12 miles southwest of Willows.
Vicinity of Sites.
10 miles west of Williams.
Vicinity of Brooks in Capay Valley.
Vicinity of Capay.
Yolo Hills, near Blacks.
Vicinity of Vacaville.
Montezuma Hills, vicinity of Collinsville.

Foothills of Sierra Nevada Mountains.—An investigation was also conducted on the western foothills of the Sierra Nevada Mountains bordering the eastern side of the Sacramento Valley. The foothills are often rolling or merely undulating and the timbered region is soon reached after leaving the valley slopes. Red Stem Filaree is not abundant on the hills. The beet leafhoppers were not taken on the western foothills of the Sierra Nevada Mountains bounding the Sacramento Valley and there were no indications on this side of typical Eutettix foothill breeding grounds. The location of the Sierra Nevada foothills from north to south with reference to distances and directions of the nearest towns follows:

7 miles northeast of Red Bluff.
10 miles east of Chico.
Vicinity of Oroville.
12 miles east of Marysville.
Vicinity of Newcastle.
Vicinity of Ione.

VI. Favorable Breeding Plants of Beet Leafhopper in Cultivated Area

In the cultivated area of the Sacramento Valley the most favorable breeding plants such as the saltbushes are scarce, except in the southern part of the valley. The beet leafhopper has been bred from the following species of the family Chenopodiaceae, to which the sugar beet belongs:

Table 2. Species of Chenopodiaceae from Which Beet Leafhopper has been Bred

Annual Saltbushes

1. Silverscale or Fog Weed (*Atriplex expansa*). Native.
2. Bractscale (*Atriplex bracteosa*). Native.
3. Redscale or Red Orache (*Atriplex rosea*). Introduced from Europe.
4. Crownscale (*Atriplex coronata*). Restricted to California.
5. Heartscale (*Atriplex cordulata*). Restricted to California.
6. *Atriplex parishi.* Restricted to California.
7. Spearscale (*Atriplex patula*). Native. The beet leafhopper has not been bred from this saltbush.

Perennial Saltbushes

8. *Atriplex fruticulosa.* Restricted to Sacramento and San Joaquin Valleys.

Pigweeds

9. Pigweed or Lamb's Quarters (*Chenopodium album*). Common European weed.
10. Nettle Leaf Goosefoot (*Chenopodium murale*). Naturalized from Europe.
11. Mexican Tea (*Chenopodium ambrosioides*). Naturalized from tropical America.

Weeds

12. Russian Thistle (*Salsola kali tenuifolia*). Introduced from Asia.
13. *Nitrophila occidentalis.* Native.

In the Sacramento Valley, the beet leafhopper was bred from Orchard Morning Glory (*Convolvulus arvensis*) which is the most troublesome weed in the beet fields of California.

VII. Climate

It is evident that the food and breeding plants on the foothills of the Coast Range and in the cultivated region of the Sacramento Valley are not the limiting factors which prevent the beet leafhopper from establishing itself. Climatic barriers determine whether the foothill breeding grounds are unfavorable to the beet leafhopper in this valley. A comparison of the humidity, sunshine and temperature in the migratory and natural breeding areas will be given.

Humidity.—The winter humidity is high on account of the rains and fogs in the Sacramento Valley. A low atmospheric humidity accompanied by cloudless skies is usual throughout the summer. In the southern portion of the valley the relative humidity is about 10 per cent higher than at the northern part.

Precipitation.—A comparison of the average rainfall in the Sacramento and San Joaquin Valleys shows some striking differences. The rainfall increases northward in the Sacramento Valley and varies from 19.28 inches at the city of Sacramento near the southern boundary of the valley to 24.9 inches at Red Bluff in the northern extremity. The precipitation is considerably less upon the west side of the valley than in corresponding localities upon the east side. The rainfall along the west side decreases from the south to about the central part of the valley and then increases to Red Bluff. The rainfall along the east side increases from south to north throughout the valley. The following figures show the average rainfall from south to north at the weather bureau stations situated in the western and eastern halves of the valley:

Table 3. Average Rainfall from South to North in Sacramento Valley

Western Half	Inches	Eastern Half	Inches
Vacaville	26.65	Sacramento	19.28
Woodland	18.29	Marysville	20.39
Colusa	16.21	Oroville	27.75
Willows	16.41	Chico	23.14
Corning	21.36	Red Bluff	24.92

In the San Joaquin Valley the rainfall decreases from north to south, and with minor exceptions is considerably less on the west side of the valley than on the eastern side. Stockton, in the northern part of the San Joaquin Valley has an annual rainfall of 14.57 inches while Bakers-

field, in the southern part of the valley has 5.39 inches. Table 4, gives the annual rainfall of towns on the western and eastern sides of the valley:

TABLE 4. AVERAGE RAINFALL FROM SOUTH TO NORTH IN SAN JOAQUIN VALLEY

Western Half	Inches	Eastern Half	Inches
Antioch	12.94		
Tracy	10.37	Milton	21.90
Westley	10.66		
Newman	11.88	La Grange	16.91
Los Banos	8.52		
Dos Palo.	8.29		
Mendota (near valley trough)	6.29		
Coalinga	8.06	Lemoncove	15.95
Maricopa	8.04	Porterville	10.02

FOG.—Fog is common during the winter months, but decreases in density and frequency of occurrence northward in the Sacramento Valley. In the southern part of the valley, fog is dense during the night and morning, but frequently disappears or lifts during the day, though sometimes continuing as a high fog for several days. The lower lying parts of the valley are sometimes subject to light fogs in the autumn and spring, when other portions are free from it.

Fog probably delays the spring migration of the beet leafhopper into the Sacramento Valley. During foggy days the bugs are sluggish and inactive, and when fog occurs before sunset no activity is displayed by the adults.

DEW.—An unfavorable factor to the overwintering beet leafhopper may be the heavy dew which occurs during the rainy period in the Sacramento Valley.

SUNSHINE.—The Sacramento and northern part of the San Joaquin Valleys have a lower percentage of sunshine than the middle and southern San Joaquin Valley.

TEMPERATURE.—The foothill slopes up to about 1,200 feet elevation in the Sacramento Valley have a minimum temperature during the winter months of 1° to 5° higher than that over the flatter and lower part of the valley floor. The difference in temperature between the sloping positions and the valley floor ranges from about 5° to 8° in the upper San Joaquin Valley.

VIII. BARRIERS

In all probability the exterminating factor of the overwintering beet leafhopper in the Sacramento Valley is humidity. The rainfall in this valley varies from 19.28 to 27.75 inches. The hot dry summers in the

Sacramento Valley are favorable to the migrant and later generations in the cultivated area.

Since our investigations were conducted in the Sacramento Valley during the past four successive outbreaks of the beet leafhopper from 1918–1921, we have no evidence to show whether the pest is found only in this valley during periods of abundance as suggested by Ball (1). Future observations will determine whether a migration takes place into the Sacramento Valley in years when no general outbreak of the beet leafhopper occurs.

IX. Acknowledgments

We are deeply indebted to Mr. G. E. Springer, General Manager and the Board of Directors of the Alameda and Union Sugar Companies for employing Mr. A. J. Basinger and financing the work during the beet season of 1920–1921. The Atriplexes were kindly determined by Dr. H. M. Hall and the common names of the saltbushes used in this paper will appear in a forthcoming monograph from the Carnegie Institution, Washington, D. C.

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FACTS CONCERNING NATURAL BREEDING AREA OF BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER) IN SAN JOAQUIN VALLEY OF CALIFORNIA

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I. Introduction

Sugar mills have been built in a natural breeding area of the beet leafhopper (*Eutettix tenella* Baker) and in such localities the frequent occurrence of curly leaf (curly top or blight) have closed the factories after enormous losses have been sustained. In the San Joaquin Valley four factories were erected in the natural breeding districts of this insect and after the 1919 outbreak of the pest, three of these mills were closed permanently. Since then the sugar mills at Corcoran and Visalia have been dismantled and moved to Preston and Whitney, Idaho.

Investigations have been conducted in the San Joaquin Valley during the past four years and the factors associated with the natural breeding grounds of the leafhopper will be discussed in this paper.

II. FAVORABLE BREEDING PLANTS OF BEET LEAFHOPPER IN CULTIVATED AREA

The most noticeable feature in regard to one condition which is favorable for an enormous increase of the leafhopper in the San Joaquin Valley, is the abundance of the host plants upon which this insect feeds and deposits its eggs in the cultivated area. In 1919, we (4) published a paper showing the relative number of beet leafhoppers captured on plants growing in the cultivated area of the San Joaquin Valley and also a list of plants in which eggs were deposited. The plants upon which enormous numbers of nymphs and adults were taken are representatives of the Saltbush Family (*Chenopodiaceae*) to which the sugar beet belongs. The hopper was bred from eggs deposited in 35 species of plants growing under natural conditions in the cultivated area. Later investigations showed, however, that although the females may deposit eggs in certain plants, the nymphs are not able to acquire the winged stage by feeding on these plants. Our breeding experiments also indicate that the most favorable host plants in the cultivated area are the representatives of the *Chenopodiaceae* and closely related families.

Wherever man has injuriously disturbed the natural conditions in the San Joaquin Valley, vast areas of annual saltbushes (*Atriplexes*) occur. These plants, which grow on alkali soil, are commonly found along roadsides and highways. Dense masses of these plants occur along fences. During the autumn and winter, the stalks of the larger species break off near the soil and are rolled along the ground by the wind scattering the seeds. The weeds pile up along barb-wire fences dropping their seeds and this probably explains why certain species of *Atriplex* are so common along fences. Miles and miles of saltbushes grow along railroad tracks. Vacant fields are often covered with thick growths of these alkali plants. Alkali sinks are surrounded by dense masses of this vegetation but often the black alkali is too strong for their development. After the grain is harvested, the stubble fields become covered with *Atriplex*. Hay and straw stacks are commonly surrounded by saltbushes. Irrigation and drainage canals are favorable locations for the development of this alkali vegetation.

What has been the stimulus for the development of enormous areas of annual saltbushes in the San Joaquin Valley? According to Kelly (3) "several hundred thousand acres in the San Joaquin Valley, which were comparatively free from alkali previous to the advent of irrigation,

have already been seriously injured, or abandoned." According to this same writer, alkali finds its way into good lands by the use of saline irrigation water, and by the rise of the ground water level through seepage and over-irrigation.

Among the *Chenopodiaceae* the saltbushes are most favorable for the enormous increase of the beet leafhopper. The following list of Atriplexes found in the San Joaquin Valley, shows whether the different species are native to this country, restricted to California or introduced from other countries:

List of Saltbushes Found in San Joaquin Valley

Annuals

1. Silverscale or Fog Weed (*Atriplex expansa*). Native.
2. Bractscale (*Atriplex bracteosa*). Native.
3. Redscale or Red Orache (*Atriplex rosea*). Introduced from Europe.
4. Crownscale (*Atriplex coronata*). Restricted to California.
5. Heartscale (*Atriplex cordulata*). Restricted to California.
6. Arrowscale (*Atriplex phyllostegia*). Native.
7. *Atriplex parishi*. Restricted to California.
8. Spearscale (*Atriplex patula*). Native.
9. *Atriplex tularensis*. Restricted to San Joaquin Valley.

Perennials

10. *Atriplex fruticulosa*. Restricted to Sacramento and San Joaquin Valleys.
11. Australian Saltbush (*Atriplex semibaccata*). Introduced from Australia.
12. Allscale or Cattle Spinach (*Atriplex polycarpa*). Native.
13. Lenscale or Quail Brush (*Atriplex lentiformis*). Native.
14. *Atriplex spinifera*. Restricted to San Joaquin Valley.

In a dry autumn, when no green pasture vegetation occurs on the plains and foothills, the shrubby, perennial Atriplexes serve as food plants for the winter brood which returns to the plains and foothills during October and November. After the pasture vegetation germinates, the adults leave the perennial Atriplexes, feed and deposit their eggs mainly on *Alfilaric* or Red Stem Filaree (*Erodium cicutarium*). In a normal season of rainfall, however, the winter generation feeds on Red Stem Filaree directly, and no large numbers of adults are found on the shrubby, perennial Atriplexes during the autumn. The hopper has been bred, however, from one shrubby, perennial saltbush, *Atriplex spinifera*, under natural conditions, the eggs probably being deposited in the leaves.

The beet leafhopper has been bred from four pigweeds growing in the cultivated area of the San Joaquin Valley. Among the following pigweeds, the Nettle-Leaf Goosefoot (*C. murale*) is the most favorable breeding plant: Pigweed or Lambs Quarters (*Chenopodium album*),

common European weed; Nettle Leaf Goosefoot (*Chenopodium murale*), naturalized from Europe; Mexican Tea (*Chenopodium ambrosioides*), naturalized from tropical America; *Chenopodium leptophyllum*, native.

Another favorable host plant belonging to the *Chenopodiaceae* is the Russian Thistle (*Salsola kali tenuifolia*). This obnoxious weed is a native of Asia and first appeared near Bakersfield in 1895, and is abundant and highly pernicious in many parts of the San Joaquin Valley. Enormous hordes of leafhoppers develop on this plant in the middle and southern parts of the valley.

The beet leafhopper has been bred from one other host plant (*Nitrophila occidentalis*) belonging to the *Chenopodiaceae*, and both nymphs and adults are commonly found on this plant in the San Joaquin Valley. It is found on moist alkali soils, often on black alkali in California, Nevada and Oregon.

A plant from which the beet leafhopper has been bred and upon which large numbers of nymphs and adults are commonly taken in the field is the Lowland Purslane (*Sesuvium sessile*) belonging to the Carpet Weed Family (Aizoaceae). This plant is found on river lowlands and alkali fields in the San Joaquin Valley.

III. Favorable Breeding Plants of Beet Leafhopper on Plains and Foothills

There existed on the plains and hills of California an abundance of grasses, clovers, and wild flowers, until man disturbed the natural conditions. As early as 1773, the Spaniards disturbed the native conditions by introducing sheep which carried in their wool seeds of plants from the Mediterranean basin. An active competition between the native and introduced plants has occurred to such an extent that most of the native species have been greatly diminished. In all probability, the original foothill host plants of the beet leafhopper were encroached upon by the introduced plants. A special adaptation of the leafhopper to *Alfilaree* or Red Stem Filaree (*E. cicutarium*) occurred, which has spread to the barren hillsides and dry plains. Cattle and sheep have overgrazed the preferred introduced forage plants so that these were not permitted to produce seeds abundantly. It is these over-grazed foothills in the semi-arid regions that are the most favorable habitat of this insect. The enormous area which the Red Stem Filaree now covers according to Thornberg (6) in parts of Washington, Idaho and Texas, and the whole of Oregon, California, Nevada, Arizona, New Mexico and Utah furnished an enormous increase in the food supply of this pest, compared with the original, native host plants. It was the disturbance

of the native conditions on the plains and foothills and in the cultivated area that has increased the most favorable food and breeding plants of the leafhopper and hence has increased the opportunities for an enormous multiplication of the pest when climatic conditions are favorable.

IV. Favorable Habitat of Beet Leafhopper

Investigations conducted on the plains, canyons and foothills after the autumn flights of the beet leafhopper lead to the discovery of the most favorable habitat of this insect in the San Joaquin Valley. A brief account of the observations made during the rainy season of the past three years will be given.

We (4, 5) have published the results of our observations conducted during 1918, on the autumn dispersion of the leafhopper and recorded large numbers of the pest on the plains and foothills of the Coast Range, Tehachapi foothills in the vicinity of Tejon Pass and Sierra Nevada foothills four miles east of Famosa to Bakersfield. The pasture vegetation germinated after the heavy rains which fell on September 11–13, and wherever the Red Stem Filaree was swept with an insect-net the hoppers were captured during October and November. Nymphs were also taken on the plains and foothills; these probably hatched from eggs deposited by the summer brood adults which acquired the winged stage during late summer or early autumn. A trip was taken on December 13, to the Tehachapi mountains which were snow-capped; no leafhoppers were observed on the foothills but 50 specimens were caught in two hours on the plains about five miles north of the foothills. During January no investigations were made but in February and March, a marked reduction of the overwintering forms was observed on the northern foothills and in canyons. A remarkable peculiarity noted in April, was the fact that the pale green adults of the spring brood were rarely captured on the foothills and in canyons in the northern portion of the San Joaquin Valley.

During December large numbers of Jassids were collected on the foothills bounding a canyon (13 miles southwest of Tracy) in the northern part of the San Joaquin Valley and when these were confined in cages in the greenhouse at Berkeley, they died as a result of a fungus disease. The weather bureau records kept by the Spreckels Sugar Company at Manteca showed that the precipitation from September to April was 17.29 inches; 9.98 inches of rain fell from September to December. We (4, 5) have published the fact that heavy rains kill some of the leafhoppers in the cultivated territory.

During the rainy season of 1919-1920, a comparative study of the beet leafhopper was made in Ingram Canyon situated opposite the northern part of the San Joaquin Valley and in Wild Cat Canyon opposite the middle portion of the valley. In both canyons large numbers of adults had congregated on perennials during the autumn dispersion. The pasture vegetation did not germinate until after the heavy rains which fell on December 1-6, and the bugs then left the perennials and were found on the Red Stem Filaree. A reduction in the number of dark overwintering forms occurred in both canyons between our visits on January 15-16 and February 11-13. It was observed that the females displayed no activity until sunset, the flights were exceedingly low over the short Red Stem Filaree and the movement was from the mouth toward the interior of the canyon. Few specimens were captured by sweeping with an insect-net, but by disturbing the Red Stem Filaree with the hand the adults made several small leaps and were often taken with a pipette. During the autumn flights the insects were commonly attracted to the wind-shield of the automobile but in the winter this behavior did not occur. A striking peculiarity was the fact that only a single pale green leafhopper of the spring brood was taken on the floor of Ingram Canyon on April 21. In Wild Cat Canyon 45 first generation adults were captured on the floor of the canyon and foothills from 1 p. m., until sundown on April 19. During the past two years dark overwintering forms were abundant in canyons in the northern part of the San Joaquin Valley but in the spring instead of an increase a marked reduction of the pale green specimens was evident.

The winter months from December to February were warm and dry but cold weather and heavy rains prevailed during March. The precipitation from September to February at Manteca was 3.96 inches, and a total of 9.19 inches for the season. No fungus diseases developed with any of the Jassids collected.

During the winter and spring of 1920-1921, it was again found that the dark overwintering adults were more abundant than the spring brood in Hospital Canyon (12 miles south of Tracy) situated in the northern part of the San Joaquin Valley. A comparison was made of the number of first brood adults captured on the hillsides in the lower and middle sections of the valley. Sweepings were made on the sunny slopes of Hospital Canyon at intervals of 100 feet to the summit at an elevation of about 1,000 feet, and an average of two adults to 50 sweeps of the insect-net were captured. The number of first brood specimens taken on the Panoche hillsides located in the middle portion of the valley, however, varied from 4-61 in the same number of sweeps.

LITTLE PANOCHE VALLEY.—An examination was now made of the mountain passes and a remarkable discovery was made on April 20, 1920. Hundreds and hundreds of pale green leafhoppers were swarming at sunset on Red Stem Filaree on April 24, in Little Panoche Valley into which the entrance of Panoche Pass opens from the middle section of the San Joaquin Valley. During the calm evening on April 28, the adults were common in the air at dusk; the hoppers assembled on the automobile and mating was observed. The flight of the insects could not be followed to any great distance on account of the approaching darkness, but they flitted about everywhere. Investigations were made from the mouth of Little Panoche Valley following the river benches of Little Panoche Creek via Mercey Hot Springs to the summit, a distance of 12 miles, and swarms of pale green specimens flew about at sunset when the pasture vegetation was swept with an insect-net. Enormous numbers of spring brood forms were found in Little Panoche Valley to the foot of Ortigalita Peak.

PANOCHE VALLEY.—Investigations were conducted in Panoche Valley, situated between the two Coast Ranges, but the bugs were not abundant on Red Stem Filaree growing in the cultivated fields. When the hills are covered with shrubs and trees, as is the case on the second interior Coast Range, beet leafhoppers are very rarely captured on Red Stem Filaree.

PANOCHE HILLS.—During 1920–1921, the investigations were extended to the Panoche Hills bounding the San Joaquin Valley. The dark overwintering adults were common on the Panoche Hills but specimens were rarely taken on the Griswold Hills not bounding the San Joaquin Valley and to the south of the Panoche Hills. During the winter the insects were most abundant on the sunny slopes of the hills.

A trip encircling the Panoche Hills was taken; nymphs and an occasional spring brood adult were taken on the hillsides along Little Panoche Creek as early as March 17. Nymphs and first brood adults were more abundant on the hillsides along Big Panoche Creek, situated about 10 miles southeast of Little Panoche Creek, indicating an earlier development. It was evident that a marked reduction of the overwintering females had occurred due to the fact that they were at the end of their natural life, having deposited their eggs and died.

An interesting observation was made during April. Large numbers of pale green adults were found on the sunny slopes of the Panoche Hills on April 6 where the dark overwintering forms were found during the winter. As the Red Stem Filaree became dry on the hillsides a movement up to the crest of the hills and down to the floor of the canyons

occurred. When the pasture vegetation became dry on the hilltops and floor of Little Panoche Valley, the nymphs and adults assembled on Filaree growing in the drainage furrows and when this food supply became dry the hoppers congregated on annual and perennial plants. MOUNTAIN PASSES.—An examination was made of other mountain passes but up to the present time no enormous assemblage of beet leafhoppers has been found. In Pacheco Pass, about 28 miles north of Little Panoche Valley, the Red Stem Filaree was tall and dense. Spring brood leafhoppers are rarely taken in tall pasture vegetation. In the Coalinga-King City Pass, situated about 50 miles south of Little Panoche Valley the Red Stem Filaree was short and resembled somewhat the condition on the Panoche Hills, but no large congregation of hoppers were found. In the Altamont Pass, about 80 miles north of Little Panoche Valley, the spring brood adults were rarely taken.

It is evident that in canyons and mountain passes of the northern part of the San Joaquin Valley, there are limiting factors which check the multiplication of the beet leafhopper. We have no evidence to show whether the eggs failed to hatch or the recently hatched nymphs succumbed on the foothills. At Manteca eggs deposited in the foliage of sugar beets from November 1 to January 15, 1919 failed to hatch out-of-doors. During the winter a high mortality of the nymphs occurred which hatched from eggs deposited during September and October.

The character of the Red Stem Filaree may be an indicator of favorable Eutettix foothill breeding grounds, but nevertheless, there may be composite controlling factors which hold this insect in check in *some* of the canyons and mountain passes of the northern part of the San Joaquin Valley. Cold winds and fogs sweeping from San Francisco Bay through the Altamont Pass, extending east and west through the Coast Range may be a critical factor in reducing the number of recently hatched nymphs. Cloudiness, rainfall, wet soil and dense pasture vegetation may be other related factors affecting the recently hatched nymphs. In years with an abundance of rainfall, fungus diseases may reduce the number of dark overwintering forms.

Let us now compare some of the apparently favorable factors of the beet leafhopper on the Panoche Hills. Little Panoche Creek flows south for about six miles from the summit of the Coast Range and then meanders southwest for another six miles to the entrance of the mounttain pass. It is evident that the slope exposure in Little Panoche Valley is far more favorable than in a mountain pass extending east and west through the Coast Range and with a break in the mountain range at the coast. Hall (1, 2) has determined mathematically that "the

amount of heat received by a slope with the most favorable gradient is 1.4 times as great as that received by an equal area of land other conditions being constant." The cold winds and fogs from Monterey Bay sweep up the Salinas Valley but on hot days the ocean breeze is very marked on the summit of the interior hills of Little Panoche Valley. No weather bureau records are available as to the precipitation in the Panoche Hills but at Mendota near the valley trough the average rainfall is 6.29 inches; the total amount for the driest year (1897) was 3.79 inches and for the wettest year (1906) was 10.48 inches. The character of the days from sunrise to sunset during the spring is different from the northren part of the San Joaquin Valley, there being fewer cloudy or part cloudy days. The middle portion of the San Joaquin Valley has a higher percentage of sunshine than the northern section of the valley. No further discussion is necessary with reference to the foothill pasture vegetation. It is evident that the vegetation, rainfall, humidity of the air, cloudiness, temperature and possibly other factors may play an important role as to the relative abundance of the beet leafhopper in certain parts of a natural breeding area.

Is there any danger of the beet leafhopper becoming a serious pest in the future in localities where the favorable host plants are absent or do not occur abundantly? As more alkali lands are placed under cultivation in the arid and semi-arid regions, and the alkali salts are brought to the surface, the Atriplexes and other alkali loving plants will increase, offering opportunities for enormous multiplication of the insect. The Red Stem Filaree may spread to the foothills in localities of the western states where it does not occur, furnishing a favorable host plant for the first brood. Although this migratory leafhopper may encounter favorable host plants, nevertheless, climatic barriers may prevent the establishment of the pest.

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Mr. L. O. Howard, Entomologist, Bureau of Entomology, United States Department of Agriculture, Washington, D. C., was present and responded to a request by Mr. Lovett to give an informal talk at this time.

INFORMAL TALK GIVEN BY MR. L. O. HOWARD, THURSDAY MORNING, JUNE 22, 1922.

Mr. Chairman, you are very courteous to call on me. I am totally unprepared to say anything except to express my pleasure at being present. I have long wanted to be present at one of the Western meetings but it so happened that I have been unable to attend before.

The economic entomologist, wherever he may be, must be tremendously gratified by the great benefit which our branch of the science in the world at large has been. We are getting better contact with other fields of science and they realize that we are working in a scientific way. Economic entomology is thoroughly scientific and it is not a branch of Zoology. I was in communication with a man who said that he was more of a scientific man than all of those fellows at the museum. I do not mean to under-estimate the work of the men of the museum. I am glad that we are going to convene with their meeting. I believe that all entomology is economic entomology, however, and before we get through with this thing we are going to know everything about every single insect. There is considerable very fine work being done by the men in the laboratories. I wish, however, that the laboratories would devote more time to a group that has more practical importance than the individual insect. All these men are doing work that is of economic value. I would like to say for the encouragement of the museum men—I see Mr. Van Duzee over there, one of the museum taxonomists, Mr. Hagan, said that he was afraid that the economic men were getting ahead of the Taxonomists. I believe that they should work along with the economic men and that their work should be encouraged in every way. A new weevil entering sweet potato fields in Mississippi put in an appearance. Now all the economic men knew what this weevil was but they did not know whether they could expect to cultivate a crop or not until we had sent it to the National Museum and had it examined. To our regret we found that it was a characteristic weevil from the region of Chili and Peru. We were able to find out more about it after we got its name and it has been doing considerable work in Australia. If we did not have these taxonomic experiences, we would not have had the benefit of the work in Australia. I will again state, however, that I consider all entomologists economic entomologists.

Some of them may object to being called this but they are just the same.

Mr. Lovett asked if there were any papers which were missed and called for these if there were any as this could have occurred since the Secretary could not be present and the program was arranged late. There were no outstanding papers to be read.

Mr. Edgar M. Ledyard announced that his office was 904 Newhouse Building and that he would be very glad to extend any courtesies possible to members and hoped that they would call upon him at any time if their movements around the country could be facilitated or if they wanted to get in touch with collecting areas or infested areas, or if they wished to establish financial connections.

The matter of meeting at 2 P. M., then adjourning to meet with the Pacific Coast Entomological Society and the Entomological Society of America as per motion duly seconded and carried, was discussed and Mr. Ledyard was requested to put a notice on the door of Room 44 of the Industrial Building to this effect.

At 11:55 A. M., it was moved, seconded and carried that, since there was no more business to come before the meeting at this time the meeting be adjourned in order that there might be time for visiting.

NICOTINE DELIVERY FROM DUST CARRIERS[1]

By WILLEM RUDOLFS, Ph.D., *Biochemist N. J. Agricultural Eperiment Stations*

During a study of nicotine dusts the problem to improve nicotine delivery from dust carriers appeared to be essentially of a chemical nature with some physical factors involved. A number of analysed clays were impregnated with definite amounts of nicotine sulfate and the evolution of nicotine from the impregnated dusts determined by drawing a stream of air conditioned to 80° F and 73.6 per cent relative humidity through the dust at a rate of one liter in 10 minutes.

The results showed a great difference from the different dusts, ranging from 0.35 per cent nicotine evolution in 48 hours to 16.15 per cent. In comparing the results of nicotine delivery from clay carriers with the free acidity of the clays no close correlation could be observed, but if the amounts of calcium and magnesium oxids together with the hydrogen-ion concentrations of the clays was compared with the nicotine evolution a more apparent correlation was noticed. An examination of the absorption, water-holding capacity and flocculation data of the clays together

[1]Paper No. 99 Journal Series, Department of Entomology, N. J. Agricultural Experiment Station.

with the chemical results and the nicotine delivery, emphasized the fact that the physical conditions of the clays played a role. For the study of partial inhibition of the nicotine delivery by the colloidal condition of the clays pure silica was mixed with different amounts of a given clay, and the mixtures impregnated with nicotine sulfate. The results seemed to indicate that the nicotine evolution from carriers mixed with nicotine sulfate is mainly a chemical phenomenon.

Pure silica was thereupon thoroughly mixed with representative chemicals in a ball mill and afterwards impregnated with nicotine sulfate at a basis of 2 per cent nicotine. Some of the results obtained are given in table 1.

TABLE 1. EVOLUTION OF NICOTINE FROM SILICA MIXED WITH CHEMICAL ACTIVATORS, IMPREGNATED WITH 2 PER CENT NICOTINE IN THE FORM OF NICOTINE SULPHATE.

No.	Carrier			Percent nicotine after 48 hours.
30	Silica	+10 %	CaO	18.29
31	"	+2%	$NaNO_3$	12.82
34	"	+2%	Na_2CO_3	24.52
36	"	+10%	$CaSO_4$	11.03
37	"	+2%	$CaCl_2$	1.60
38	"	+2%	NH_4Cl	3.53
39	"	+7.5%	$CaCO_3$	26.30
40	"	+1%	$NaOH$	2.16
47	"	+10%	$Ca(OH)_2$	5.40

The data in the tables are in all instances relative and therefore can be used only for a comparison of the relative nicotine evolution from the dusts under certain definite conditions, as moisture, temperature, air velocity and amount of carrier.

An examination of the data in table 1 shows that the carbonates most readily react with the nicotine sulfate. Calcium carbonate and Magnesium carbonate separately gave better results than any of the other activators used, but a mixture of $CaCO_3$ and $MgCO_3$ proved to be best, Magnesium seemingly acting as a catalyser. Such a mixture was found in the form of dolomite (Magnesium limestone). Dolomite evolved after 48 hours 31.7 per cent nicotine. The reaction between the nicotine sulfate, taking the place of a weak acid, and the carbonates, is probably through replacement of the sulfate radicle by the carbonate radicle and a subsequent volitalisation of the nicotine. Determinations made of soluble and insoluble sulfates before and after the subjection of the mixtures to a stream of air showed a decided increase in insoluble sulfates ($CaSO_4$).

It is apparent that under these conditions the influence of moisture upon the evolution of nicotine from carriers must be considerable. The data given in table 2 indicates conclusively the importance of moisture.

TABLE 2. INFLUENCE OF MOISTURE UPON THE EVOLUTION OF NICOTINE FROM CARRIERS IMPREGNATED WITH NICOTINE SULFATE.

No.	Carrier	Percent moisture in stream of air	Percent nicotine after 48 hours	Percent nicotine after 120 hours
A	Dolomite	73.4	31.68	66.32
B	"	37.0	26.18	47.75
C	"	dry	15.27	32.77
D	Sea Sand	73.4	6.52	12.28
E	" "	37.0	8.97	13.68
F	" "	dry	21.41	32.20

The fact that approximately the same amount of nicotine evolved from dry sea sand and dry dolomite after 120 hours may be the reason why in arid regions the character of the carrier has not such a great influence as in the Eastern part of the United States. It is interesting to note that the nicotine evolution from sea sand impregnated with nicotine sulfate is inverse to the moisture conditions of this carrier as compared with the moisture conditions of the dolomite carrier impregnated with nicotine sulfate. These data seem to furnish additional proof that surface phenomena play an important role. Theoretically, the chemical reaction should take place at a greater speed when a stream of air is charged with moisture to approximate saturation, but the nicotine evolved seems to be reabsorbed by the precipitating moisture or the moisture present in the dust and less nicotine was set free than with air of a relative humidity of 73 per cent. Temperature also has a decided influence upon the nicotine evolution of nicotine sulfate dusts.

Since the moisture content of the nicotine sulfate solutions (40 per cent nicotine) cannot be reduced without serious difficulties in the manufacturing process, experiments were undertaken with so called "free" nicotine solution, analysing approximately 96 per cent nicotine. Some of the most significant figures secured under similar conditions are:

	Percent nicotine after 48 hours	Percent nicotine after 120 hours
Sea Sand	22.80	49.26
Dolomite	24.78	52.48

It could be expected that only slight differences should occur since little reaction could take place between the weakly acid liquid, charged with "free" nicotine, and the carriers. The continuous air current together with the relative high temperature drive off the "free" nicotine as a gas from the carriers or absorbents. None or very little chemical reaction takes place between the carriers and the "free" nicotine solution. The following results, reporting the influence of moisture upon the evolution of nicotine from carriers impregnated with "free" nicotine solution, show this clearly:

	Percent moisture in stream of air	Percent nicotine after 48 hours
Sea Sand	73.0	22.81
" "	1.0	41.70
Dolomite	73.0	24.78
"	1.0	35.58

Sea Sand is a poorer absorbent than dolomite and releases more nicotine with an approximately dry air stream than dolomite. The wetting of the sand causes a film of moisture to cling to the particles and a part of the moisture is easily evaporated by the air, while some of the liquid may be absorbed or has greater adhesion in the case of dolomite.

Sand is too heavy to be used for practical purposes for a considerable force is necessary to blow it for sufficient distribution. For dusting ground crops Magnesium limestone seems a good carrier, is cheap and convenient, does not burn the plants and has a good adhering quality; it can be used to advantage with nicotine sulfate and "free" nicotine. For orchard dusting a light fluffy carrier is needed. In the case of "free" nicotine liquid ordinary hydrated lime can be used and with nicotine sulfate hydrate of lime with 10 per cent dolomite which gives about as good nicotine delivery as dolomite alone.

Conclusions

I. Nicotine derived from nicotine sulfate:

1. Is evolved less rapidly from a colloidal than from a crystalloidal carrier.
2. Is evolved most readily when a large percentage of carbonates (Ca and Mg) is present.
3. Is evolved more readily under influence of high temperature and high atmospheric moisture conditions.

II. Nicotine derived from high strength (95%) "free" nicotine solution:

1. Is evolved more readily from a crystalloidal than from a colloidal carrier.
2. Is evolved from dolomite, hydrated lime, etc. at approximately the same rate.
3. Is evolved more rapidly under high temperature and low atmospheric conditions.
4. Is evolved much more rapidly under high temperature and low atmospheric conditions than from nicotine in the sulfate form.

IS THE HOUSE-FLY IN ITS NATURAL ENVIRONMENT ATTRACTED TO CARBON DIOXIDE?

By CHARLES H. RICHARDSON and EVA H. RICHARDSON

Several years ago, experiments with ammonium carbonate and certain other compounds were reported [1,2] which indicate that the female house-fly (*Musca domestica* L.) is attracted to fermenting organic substances largely by the odor of ammonia. These experiments were conducted in the open in places habitually frequented by house-flies. All indications pointed to the fact that the oviposition responses of these flies were normal. Since then, Crumb and Lyon [3,4] using a somewhat different method have concluded that carbon dioxide induces the house-fly to oviposit in fermenting substances, but that ammonia does not possess this attracting influence. The authors carried out their experiments in a large wire cage in which the reactions of flies that had previously been captured in traps were observed. Furthermore, bran was employed as the nidus, a substance not used in our work referred to above. In view of these differences, it seemed desirable to test the attractiveness of carbon dioxide with bran as a nidus under outdoor conditions. In addition, the attractiveness of bran containing ammonium carbonate was investigated, a combination which as Baumberger[5] has already shown will induce egg-laying. The experiments described below were made at Clarendon Virginia from July 13 till August 18, 1922.

The location selected for these experiments was the southwest side of a dwelling house in a place not subject to strong air currents. It was shaded till midday and lightly shaded during a part of the afternoon. One series of experiments was placed in a different location which received more sunlight during the morning and at midday.

The experimental receptacles (funnels or dishes) were placed on a wooden shelf in a linear series 2 feet apart. A shelf below this held the carbon dioxide generators. In each series there were always more carbon dioxide than ammonium carbonate experiments. The position

[1]Richardson, C. H. A chemotropic response of the house-fly (*Musca domestica* L.) Science n. s. 43, 613-6 (1916)

[2]———— The response of the house-fly (*Musca domestica* L.) to ammonia and other substances. N. J. Agric. Expt. Stations Bull. 292, 19 pp. (1916).

[3]Crumb, S. E. and Lyon, S. C. The effect of certain chemicals upon oviposition in the house-fly (*Musca domestica* L.) J. Econ. Entom. 10, 532-6 (1917).

[4]———— Further observations on the effect of certain chemicals upon ovipositon in the house-fly (*Musca domestica*) J. Econ. Entom. 14, 461-5 (1921).

[5]Baumberger, J. Percy. A nutritional study of insects, with special reference to microorganisms and their substrata. J. Exptl. Zool. 28, 1-81 (1919).

of the individual experiments was changed daily. The duration of each series of experiments varied from 5 to 11 hours; in nearly every instance it covered the time from 11 A. M., till 4 P. M., when flies were most abundant and active. During showers the receptacles were covered.

Flies were always present but never abundant in this location; 17 was the largest number counted at any time. For this reason, a small number of experiments was run almost daily throughout the period covered by this investigation rather than a large number for a short period of time.

The bran employed was a sterilized commercial product, especially prepared for culinary purposes. It consisted largely of wheat husk. Except in a few instances, it was not sterilized before use. All chemicals were of C. P. grade. Well water was used in all solutions and for other purposes where water was required.

The carbon dioxide used in these experiments was liberated from sodium carbonate by means of sulfuric acid. The acid (specific gravity 1.84) was diluted to 20 percent. by volume before use. A generator consisting of a 400cc. salt-mouth bottle or a milk bottle of pint or quart capacity equipped with a dropping funnel and a glass delivery tube supplied the gas which was conducted through a rubber tube to the experimental receptacle. Forty, 50 or 100 g. of sodium carbonate in 30 to 60cc. water were decomposed by the slow dropwise addition of the dilute acid. The flow was regulated to give a steady evolution of carbon dioxide from 11 A. M., till 4 P. M., or longer. The bran nidus was exposed in the glass funnels or porcelain dishes mentioned above. The funnels were 10.2 cm. in diameter; each held a perforated procelain disk 5 cm. in diameter which prevented the bran from clogging the stem of the funnel. Each funnel contained about 15 g. bran (air dry weight) well moistened just before the experiment started. The generator tube was attached to the stem of the funnel and in this way carbon dioxide was conveyed through the bran and into the air above. The porcelain dishes measured 13.3 cm. in diameter and 2.5 cm. in depth. A piece of absorbent cotton occupied the bottom of each dish to help retain miosture; over this the bran was spread and the glass nozzle of the generator tube was thrust in the center of the bran mass. Water was added to each dish. Further details concerning the carbon dioxide dish experiments are given in table I.

Porcelain dishes were generally used for the ammonium carbonate experiments. Each dish contained a piece of cotton, 10 g. bran (in one case 20 g.) and 25 to 30 g. of solid ammonium carbonate (an equimolecular mixture of ammonium bicarbonate and ammonium

carbonate) or 50cc. of a saturated solution of ammonium carbonate. The solid ammonium carbonate (in lumps) was always covered with a thin layer of bran. Unless ammonium carbonate solution was used from 25 to 50cc. water were added to each dish. The funnel experiments with ammonium carbonate were similar to the carbon dioxide experiments in general arrangement except that a piece of wet cotton covered the porcelain disk over which the bran was spread. The funnels were supported by means of rubber stoppers in bottles which contained water. Other details are given in table II.

The controls contained only bran and water; in arrangement and amounts of these substances they followed closely the other experiments.

The following experiments are selected to illustrate the methods and results obtained.

TABLE 1. CARBON DIOXIDE AND AMMONIUM CARBONATE EXPERIMENTS IN PORCELAIN DISHES

CARBON DIOXIDE EXPERIMENTS: Generators contained 50 g. Na_2CO_3 and 30cc. H_2O; dropping funnels held 150 cc. 20 volume % H_2SO_4; each dish contained a piece of cotton, 10 g. bran moistened with H_2O and 25 to 50 cc. H_2O.

AMMONIUM CARBONATE EXPERIMENTS: Each dish contained cotton, 25 to 30 g. solid ammonium carbonate, 10 g. bran moistened with H_2O and 25 to 50 cc. H_2O.

CONTROLS: Each dish contained cotton, 10 g. bran moistened with H_2O and 25 to 50 cc. H_2O.

			Duration		Eggs deposited:		
No.	Material	Date	Hrs.	Mins.	Egg masses*	Single eggs	Total eggs
1, 4	CO_2	7-23	6	45	0	0	0
2	Ammonium carbonate	"	"	"	6	0	50
3	Control	"	"	"	0	0	0
5, 7, 9	CO_2	7-24	11	0	0	0	0
6	Control	"	"	"	0	0	0
8	Ammonium carbonate	"	"	"	0	0	0
10, 12, 14	CO_2	7-25	8	30	0	0	0
11	Ammonium carbonate	"	"	"	4	0	154
13	Control	"	"	"	0	0	0
15	Control	7-26	9	45	0	0	0
16, 17, 19	CO_2	"	"	"	0	0	0
18	Ammonium carbonate	"	"	"	2	0	82
20, 21, 23	CO_2	7-27	10	0	0	0	0
22	Control	"	"	"	0	0	0
24	Ammonium carbonate	"	"	"	7	1	126
25	Ammonium carbonate	7-29	10	20	10	21	330
26, 28, 29	CO_2	"	"	"	0	0	0
27	Control	"	"	"	0	0	0

*An egg cluster containing 2 or more eggs was considered to be an egg mass.

TABLE 2. CARBON DIOXIDE AND AMMONIUM CARBONATE EXPERIMENTS IN GLASS FUNNELS

CARBON DIOXIDE EXPERIMENTS: Generators contained 100 g. Na_2CO_3 and 60 cc. H_2O; dropping funnels held 300 cc. 20% acid; each funnel contained 15 g. moistened with H_2O.

AMMONIUM CARBONATE EXPERIMENTS: Each funnel contained a piece of cotton, 15 g. bran moistened with H_2O and 25 g. solid ammonium carbonate. The funnels were supported by means of stoppers in 400 cc. bottles containing 300 cc. H_2O.

CONTROLS: Each funnel contained 15 g. bran moistened with H_2O and was placed in a 400 cc. bottle which held 300 cc. H_2O.

			Duration		Eggs deposited:		
No.	Material	Date	Hrs.	Mins.	Egg masses.	Single eggs	Total
30,32	CO_2	8-2	9	35	0	0	0
31, 33	Control	"	"	"	0	0	0
34	Ammonium carbonate	"	"	"	3	0	144
35	Ammonium carbonate	8-3	9	40	3	0	54
36, 38	Control	"	"	"	0	0	0
37, 39	CO_2	"	"	"	0	0	0
40, 44	CO_2	8-4	5	30	0	0	0
41, 43	Control	"	"	"	0	0	0
42	Ammonium carbonate	"	"	"	0	0	0
45	Ammonium carbonate	8-5	"	"	0	0	0
46, 48	CO_2	"	"	"	0	0	0

47, 49	Control	"	"	"	0	0	0
50, 52	CO_2	8-6	"	"	0	0	0
51	Ammonium carbonate	"	"	"	1	0	52
53, 54	Control	"	"	"	0	0	0
55, 59	Control	8-7	"	"	0	0	0
56, 58	CO_2	"	"	"	0	0	0
57	Ammonium carbonate	"	"	"	0	0	0

Fifty-five carbon dioxide, 23 ammonium carbonate and 59 control experiments were completed. Carbon dioxide gave entirely negative results; the same was true of the controls. Fourteen of the ammonium carbonate experiments were positive, yielding 1890 eggs, an average of 135 eggs for the positive experiments and 82.2 eggs for the entire 23 experiments. There were 62 egg masses and 26 single eggs or an average of 4.4 masses and 1.9 single eggs for the successful experiments. In view of the small number of flies present, oviposition in 61 percent, of the ammonium carbonate experiments is considered significant. It is believed that stormy and cool weather tended to prevent oviposition on certain days.

House-flies often crawled over and fed upon the moist bran in both the carbon dioxide and control experiments. However, the preoviposition behavior of backing into crevices and extruding the ovipositor, so often manifested on bran containing ammonium carbonate, was never observed in the carbon dioxide or control experiments. We therefore conclude that the house-fly in its natural environment will not oviposit on bran from which carbon dioxide alone arises. Nor will it, under the conditions here set forth, oviposit in bran within 11 hours after it has been moistened with water. Bran, on the other hand, which evolves the final decomposition products of ammonium carbonate, e.g., ammonia, carbon dioxide, and water, will attract the house-fly and induce oviposition. Water is probably essential to induce oviposition; however, since water was common to all experiments it could hardly have influenced the choice. Carbon dioxide itself was ineffective. By elimination, then, only ammonia remains and we do not possess sufficient evidence to justify a revision of the former conclusion,[1, 2] namely, that ammonia is largely responsible for the attraction of the house-fly to fermenting organic substances. The possible attractive influence of carbon dioxide in mixtures of ammonia, water vapor and air must be admitted, although this influence is probably an augmenting rather than a determining one. The presence in the air of undissociated molecules of ammonium carbonate, even in small amounts, may also have an effect which was not detected.

Ammonium hydroxide solutions were used in 36 experiments of a preliminary character. Concentrations of 2, 5, 7, 10, and 14 percent. ammonia were made up from ammonium hydroxide containing 28

percent. ammonia. Porcelain dishes containing cotton, 10 g. bran and 50 cc. of the ammonium hydroxide solution were usually employed. On July 31, 8 eggs were found in a dish to which 50cc. of a solution containing 2 percent. ammonia had been added, and on August 5, 390 eggs were counted in a dish which held the same amount of a solution containing 14 percent. ammonia. Time did not permit a more thorough investigation of this subject, but we hope to return to it in the future. The partial success with ammonia noted here and in previous experiments[1,2] together with the negative results obtained with carbon dioxide again lead to the conclusion that the female house-fly is attracted largely by the odor of ammonia.

Aqueous solutions of ammonium carbonate and ammonium hydroxide differ in a number of particulars which may account for this difference in attraction. With solutions of equal percentage concentration of ammonia, ammonium carbonate solution evolves ammonia much more evenly than a solution of ammonium hydroxide. An ammonium hydroxide solution gives off a large part of its ammonia during the first 2 or 3 hours of exposure, while an ammonium carbonate solution evolves about one-third as much. The ammonium hydroxide solution will also have a higher concentration of hydroxyl ion. These and other differences may account for the greater attraction of an ammonium carbonate solution.

The results described by Crumb and Lyon represent, we believe, the anomalous responses of house-flies reacting in an unnatural environment.

It may be of interest to state in passing that *Stomoxys calcitrans* L. was seen almost daily in the vicinity of these experiments but never alighted on the bran. It is apparently not attracted to the compounds used in this investigation.

Conclusions

1. Bran which volatilizes carbon dioxide alone when exposed in the natural environment of the house-fly will not induce oviposition.

2. Bran which volatilizes the products of decomposition of ammonoium carbonate in aqueous solution attracts the house-fly and induces egg-laying.

3. Since carbon dioxide and water, two of the final decomposition products of ammonium carbonate, do not in themselves induce egg-laying, it is believed that ammonia is largely responsible for the attraction to ammonium carbonate.

4. The possibility of other substances exerting an augmenting influence on the attraction to ammonia is admitted, but no definite proof of it was indicated in these experiments.

5. Some preliminary experiments with ammonium hydroxide solutions were only partially successful in calling forth the oviposition response. Some possible reasons for this are mentioned.

THE ABILITY OF QUEEN AND DRONE HONEYBEES TO FEED THEMSELVES

By E. F. Phillips, *Bureau of Entomology*

In connection with some feeding experiments with worker bees to determine the digestibility of various carbohydrates, it seemed of interest to learn to what extent queens and drones are able to take food without the help of worker bees. It has generally been assumed that both queens and drones are regularly fed by the workers, and it is even sometimes believed they will starve in the midst of plenty unless they are so fed. Several observers have, however, mentioned seeing drones and queens taking food direct. In the killing of the drones at the close of the honey-flow, it is usually assumed that they are first starved by a failure of the workers to feed them and that after such treatment they are easily carried or driven from the hive.

During the morning of May 19, 1922, a colony of bees was removed to a new stand while the bees were flying freely, permitting the old field worker bees and flying drones to return to an empty hive on the old stand. A short time later the bees remaining in the original hive were shaken from their combs and allowed to return to them through a queen-excluder, thus removing the drones and causing the remaining old bees to fly so that more of them would return to the original location, it being desirable to remove both the drones and the old worker bees for projected experiments. As there was free access for the worker bees into the super containing the drones, a few remained with the drones. In the early afternoon two small wire-cloth and wood cages were filled with drones, and in both cases a few workers went with them, as will be indicated.

The cages containing the drones were placed in a dark room in the basement of the laboratory. The temperature of the room, taken daily at the time the dead drones were removed and counted, is given in the accompanying table. The temperature of this room is quite constant. The room was lighted only during the removal of the dead bees, they being taken outside for counting and the room darkened. In the same room were worker bees under similar experiments and these also were removed daily as they died. Probably the total time that the room was lighted while drones were still living never exceeded an hour daily.

The temporary lighting of the room caused both the drones and worker bees to become more active, and this in turn perhaps shortened the length of life to a small degree.

(1) *Drones without food*:—A cage containing 170 drones and 3 worker bees was placed in the dark room, and was provided with a bottle containing water, but the bees were given no food. One worker died the first day and the other two died the second day. The death rate of the drones is shown in the accompanying table. The average length of life of these drones was 2.5294 ± 0.0499 days. The last drone died on the fifth day. ($\sigma = 0.9652 \pm 0.0353$; $C = 38.16$).

(2) *Drones with cane sugar solution*:—A cage containing 144 drones and two worker bees was placed in the room at the same time. These were given a bottle feeder containing a saturated solution of cane sugar (sucrose C.P.). One worker died on the second day and the other on the fourth day. The death rate of the drones is shown in the accompanying table. The average length of life of the drones was 4.9722 ± 0.1176 days. The last drone died on the tenth day. ($\sigma = 2.0915 \pm 0.0831$; $C = 42.06$).

It is quite evident from the figures given that drones are able to take food from a bottle feeder, since the average length of life is double, within the limits of the probable errors, in the case of the drones provided with food. Since the last drone in those fed lived six days after the last worker died, there can be no question as to the possibility that the two workers in this cage fed all the drones. The condition of the living drones in the two cages was quite different also. Those without food were exceedingly sluggish at the end of the first day, while in the cage where food was provided they were quite active until almost all of them were dead. This difference which was quite evident during the experiment can not be expressed in figures.

To determine whether queenbees are also able to feed themselves, the following experiments were tried. One queenbee (No. 2) was placed alone in a small introducing cage at 11:00 A. M. on June 24. On top of this cage there was placed a small bottle feeder containing a solution of cane sugar (sucrose C.P.), saturated at room temperature (then 24.6° C.). This queen lived until 1:30 P.M. July 4, the temperature of the laboratory room during the interval being quite high. On the same date a queen (No. 1) was placed in a similar cage with nothing given except water and she was dead the following morning at 9:00 A.M. On June 29 at 2:00 P.M. another queen (No. 3) was placed in a similar cage with water only and she was found dead at 7:00 A.M. the following morning. On June 29 at 2:00 P.M. another queen (No. 4) was placed in a cage with water

only and she was found dead at 3:00 P.M. on July 1, she having been observed moving feebly at 1:00 P.M. From this one instance of the queen living ten days with food, compared with the three checks without food, it is quite evident that this queenbee was able to take food from a bottle feeder and to nourish herself. It is quite frequently observed in mailing queens that on arrival the queen will be the only individual alive, this also indicating that she is able to take food alone.

For purposes of comparison, it may be stated that at the time the drones were experimented upon a cage containing worker bees and fed cane sugar was found to live an average of 9.175±0.1291 days, the last worker dying on the 19th day. The detailed data for this feeding experiment will be used later for another purpose and is not here recorded in full.

TABLE SHOWING DEATH RATE OF DRONES

Day	Drones dead without food	Drones dead, sugar syrup	Temperature
1	16	2	19.2
2	84	12	19.8
3	40	34	19.4
4	24	22	20.6
5	6	13	19.8
6		18	19.2
7		22	21.5
8		17	19.6
9		3	17.2
10		1	19.4
Totals	170	144	

Scientific Notes

A Rice Leaf-Miner. Parts of California's rice growing districts have suffered this year from the attack of a leaf-miner identified as *Hydrellia scapularis* Loew. The flies pupated in the leaves and emerged during the last two weeks of June. One brood alone was noticed attacking in June at which time the rice was 6 to 12 inches high. The attacked leaves turned brown and lay flat on the water as if the plant were dead but after a few days of warm weather the greater portion of those affected sprouted. The attack will delay harvest which gives rise to greater danger from early rains interferring with the harvest. The injury was most noticeable in checks that were carrying an unusual depth of water, which was used to drown water grass. The seriousness of the attack was due to the weakening effect of too great a depth of water coupled with the leaf-miner injury.

E. R. DE ONG,
University of California.

Ocnerostoma piniariella Zeller, Anther Introduced Insect. Specimens of western white pine needles mined by this insect were received under date of June 29, 1922

accompanied by the statement that the material was collected in British Columbia at Hilltont's, near Abbotsford, and that the larva appears to mine one needle of the whorl and then forsakes its gallery and spins a slight cocoon between the needles, the adult issuing the latter part of July as evidenced by the forwarding of moths by Doctor J. S. Boyce, July 21st. The general character of the work is suggestive of our native pine leaf miner, *Paralechia pinifoliella* Chambs., except that this insect pupates in a loose cocoon constructed on the outside of the needles. We are informed by Doctor August Busck, who kindly determined the species, that the insect has never hitherto been recorded from outside of Europe.

E. P. Felt

Green Soldier Bug. *Nezara hilaris* Say, has recently appeared in the role of a destructive peach pest in Davis and adjacent counties, Utah. One orchardist with large holdings has lost heavily twice during the past four years. Specimens taken in this orchard were identified by Dr. E. P. Van Duzee who states that tho the insect is generally distributed throughout the West it has not previously been reported as a pest. In all respects the situation in the orchard above cited seems to be identical with that described by Whitmarsh in the Ohio Agricultural Experiment Station Bulletin No. 310. In a brief article written for the *Utah Farmer* the writer of this note has suggested the burning of all leaves, trash and debris in the orchard among infested trees during the winter, or opening these to the action of the elements. It is further suggested in the absence of accumulations of leaves etc., that small piles of leaves, straw, weeds, dry manure or similar material be provided as inviting hibernating sites late in September and that these be prevented from blowing away by suitable materials such as large weeds or light brush.

Wyatt W. Jones

Effect of Water on Larvae of Bulb Flies. It has been rumored by Dutch bulb brokers that the narcissus fly and the lesser bulb fly could be controlled by immersing the bulbs in water at room temperature for a period of twenty-four hours.

In order to prove or disprove this rumor, the following experiments were conducted.

I. Seven larvae of the Narcissus Fly (*Merodon equestris* Fab.) were placed in water at room temperature, October 20, 1922.

7 larvae lived 1 day.
3 larvae lived 3 days.
1 larvae lived 4 days.

II. Seven larvae of the lesser bulb fly (*Eumerus strigatus* Fallen) were placed in water at room temperature, October 21, 1922.

7 larvae lived 2 days.
6 larvae lived 3 days.
2 larvae lived 7 days.
1 larvae lived 9 days.

H. L. Sanford,
Entomological Inspector,
November 3, 1922. *Federal Horticultural Board*

Eois ptelearia Riley (Geometridae) Detected in the Herbarium of the Carnegie Museum. The late Professor C. V. Riley in "Insect Life," Vol. IV, 1892, p. 112,

called attention to the ravages of *Eois ptelearia* (Riley) in the Herbarium of the United States National Museum, and the late W. G. Wright in the same volume, p. 271, spoke of the insect as feeding upon stored hay.

My attention has just been called by Professor O. E. Jennings, the Curator of the Herbarium of the Carnegie Museum, to the fact that he has discovered that certain material recently collected by him was found to be suffering from the infestation of the same insect. Vigorous steps have been taken to guard against its spread in the Herbarium of the Carnegie Museum. Nevertheless it is found to have attacked quite a number of fascicles of plants dried within the last twelve months, and which had not yet been poisoned or permanently placed in the Herbarium. As noted by others, the larvae seem to have a preference for the flowers of the *Compositae*. Today I inspected an unpoisoned bundle of plants, in which the insect was found feeding upon the blossoms of various species of *Bidens*, *Solidago*, and *Eupatorium*. It also had ruined a specimen of *Gentiana* and of *Parnassia*. It feeds greedily upon the berries of *Cornus* and *Smilax*. I have not taken the time to make an inventory of all the species of plants which have been attacked, but it evidently is a very dangerous and almost omnivorous herbarium-pest. We shall succeed, no doubt, in eradicating it, but I beg my botanical friends to take warning. The creature, which was first reported as feeding upon herbarium specimens from the Southwest, seems to have spread as far as Pennsylvania, and great vigilance will be required to guard against its ravages in the future.

Carnegie Museum
Oct., 31, 1922.

W. J. HOLLAND,
Director Emeritus

Gipsy Moth and European Corn Borer. An important conference called by Commissioner of Farms and Markets, Berne A. Pyrke, was held at Albany, N. Y., Nov. 16. The Federal Government was represented by Drs. L. O. Howard, C. L. Marlatt, E. D. Ball, W. R. Walton, and Messrs. A. F. Burgess, H. L. McIntyre, L. H. Worthley and D. J. Caffrey; the Dominion of Canada by L. S. McLaine of the Inspection Service and J. M. Swaine, Forest Entomologist; the State of New Hampshire by W. A. Osgood; the State of Vermont by Harold A. Bailey in Charge of Insect Suppression; the State of Massachusetts by Dr. A. W. Gilbert, Commissioner of Agriculture, R. H. Allen, Charles O. Bailey of the Conservation Commission and George A. Smith; the State of Rhode Island by Ralph A. Sheals, Assistant Entomologist; the State of Connecticut by Dr. W. E. Britton, State Entomologist; the State of New Jersey by Dr. T. J. Headlee, State Entomologist; the State of New York by C. R. Pettis and W. G. Howard of the Conservation Commission; Commissioners Pyrke and Hogue, Dr. G. G. Atwood and B. D. VanBuren of the Department of Farms and Markets; Prof. P. J. Parrott of the Geneva Experiment Station; Prof. G. W. Herrick of the State College of Agriculture and Dr. E. P. Felt and D. B. Young of the State Museum. The N. Y. State Forestry Association was represented by its secretary, J. R. Simmons. The broader phases of the problems in relation to these two insects were discussed and substantial agreement reached in regard to a general policy. The more important conclusions will be made public in the near future.

JOURNAL OF ECONOMIC ENTOMOLOGY

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There is in eastern New England a nice illustration of the complexities arising from the indiscriminate introduction of plants and animals. It is well known that a considerable number of our most common and noxious weeds are introduced species. The same is true of insects. The European Corn Borer is one of our newest pests and not content in this county with its presumably preferred food plant, corn, it has turned to weeds and in the succulent growth on abandoned market garden areas in the environs of Boston has multiplied so extensively that in spite of the great destruction of the pests in cultivated plants following ordinary agricultural and market garden practices, there are hosts of moths coming from the weed areas and reinfesting in extreme degree not only the favorite food plant, corn, but the insects, apparently driven by scarcity of available material, are breeding upon other garden crops, such as celery, spinach and beets and herbaceous ornamentals, particularly dahlias, chrysanthemums and asters. The weeds, while seriously infested, reproduce abundantly and appear to add greatly to an infestation which might otherwise be only moderately injurious.

Current Notes

Mr. Lachlan Gibbs, a British entomologist, died in London, England, March 1, 1922.

Mr. Frank J. Rimoldi, Cornell 1916, is teaching entomology this year at the University of California.

Mr. W. R. Walton of the U. S. Bureau of Entomology spent a day at the Fredericton, N. B., Laboratory recently.

According to *Science*, the entomological laboratory and offices of the Station Agronomique de la Guadeloupe were recently destroyed by fire.

Prof. W. H. Brittain of the Nova Scotia Agricultural College spent a day recently at the Japanese Beetle Laboratory, Riverton, N. J.

Mr. Lawrence Reynolds, an entomologist and collector in Central and South America, died recently in Boston at the age of forty-four years.

A new building at the University of Missouri for which the last legislature appropriated $200,000.00 will contain a room for the entomological collections.

Mr. John B. Gill, Bureau of Entomology, attended the annual convention of the National Pecan Grower's Association, at Thomasville, Ga., October 3–5, 1922.

Recent visitors at the Federal Fruit Insect Laboratory at Sandusky, Ohio, include A. F. Burgess and Dr. A. C. Baker of the Bureau of Entomology.

Prof. H. A. Gossard during his vacation in October visited Florida, and expected to attend the annual meeting of the National Nut Grower's Association.

According to *Science*, Mr. Francis Maidl of the National Museum of Vienna, has been appointed curator of the department of entomology at Cornell University.

Mr. C. B. Nickels has been transferred from the position of field entomologist to that of research entomologist at the South Carolina Agricultural Experiment Station.

According to *Science*, Mr. John L. Buys, instructor in entomology at Cornell University, has been appointed assistant professor of entomology at the University of Akron.

Mr. E. P. Ide, temporary laboratory assistant, Entomological Branch, Ottawa, Canada, during the summer months, has resigned to continue his course of study in the Collegiate Institute.

Dr. C. L. Marlatt, Chairman of the Federal Horticultural Board, returned about October 1, to his official duties at Washington after having spent the summer in Maine.

Mr. W. W. Yothers of the Bureau of Entomology attended the County Agent's meeting held in Gainesville, Fla., September 9–14, where he discussed rust mites and their control.

Mr. W. J. Kostir, for the past year instructor in zoology at Columbia University, returned this fall to Ohio State University as assistant professor of zoology and entomology.

Mr. Dwight M. DeLong received the degree of doctor of philosophy from the Ohio State University last June, and is now assistant professor of entomology at that institution.

The Kansas State Agricultural College has granted Assistant Professor Wm. P. Hayes of the Department of Entomology, a leave of absence for the coming year to study at Cornell University.

An address on peach insects was delivered before the Kiwanis Club of Fort Valley, Georgia, on October 6th, by Mr. Oliver I. Snapp, of the U. S. Bureau of Entomology.

Dr. David Sharp, formerly curator of the Museum of Zoology at the University of Cambridge, and editor of the *Zoological Record*, died August 27, at the age of eighty-one years.

Dr. E. D. Ball is chairman, and Doctors A. L. Quaintance and A. C. Baker are members of the Committee on Preliminary Arrangements for the Graduate School for workers in the U. S. Department of Agriculture.

The following appointments to the Bureau of Entomology are announced: George W. Ellington, Lexington, Miss., July 27, to assist in meat insect investigations; E. A. Vaughn, August 22, grain-insect investigations, Thomasville, Ga.

Dr. E. D. Ball, director of scientific work in the U. S. Department of Agriculture, is national president of Gamma Sigma Delta, the Agricultural honor society. He installed a chapter at the Pennsylvania State College on October 10.

Mr. Maurice E. Phillips, dried fruit insect investigations, Bureau of Entomology, has located his laboratory at 433 Weldon Avenue, Fresno, Calif., and during the past summer has been making a special investigation of the Indian-meal moth.

Messrs. J. A. Harris and H. J. Dodd, field assistants at the Peach Insect Laboratory of the U. S. Bureau of Entomology at Fort Valley, Georgia, have resigned. Mr. Harris has accepted a position with the State Plant Board of Mississippi.

In connection with the investigation of the natural control of the larch sawfly in Canada, it has been found that one of the shrews plays an important part. A live shrew kept in captivity consumed 175 cocoons every twenty-four hours.

Dr. Henry Fox and Prof. W. A. Price of the Japanese Beetle Laboratory force, temporary appointees during the summer, have returned to their collegiate duties. Dr. Fox will return to Mercers University, Macon, Ga., and Prof. Price will return to Purdue University.

According to *Science*, Prof. F. L. Washburn of the University of Minnesota, accompanied by Mr. Cadwallader Washburn, sailed on September 8 for Tahiti and other South Sea islands. Prof. Washburn is on sabbatical leave and will make a collection of insects for the university.

The Entomological Branch arranged an interesting and instructive exhibit of insects and their work for the Canadian National Exhibition held at Toronto, August 28th to September 9th. An exhibit was also arranged for the Central Canada Exhibition held in Ottawa, September 9–18.

Professor Herbert Osborn attended a meeting at Woods Hole, Mass., August 4 and 5, of a committee raised to work out details of a plan for a federation of American Biological Societies. Professor Osborn substituted for Professor B. E. Livingston, and represented the American Association for the Advancement of Science.

According to *Science*, Dr. Charles A. Kofoid, professor of zoology, University of California, was scheduled to lecture on "Animal Foes of the Human Body," October 29, in a course of six free public lectures concerning science and health at the California Academy of Sciences, Golden Gate Park, San Francisco, Cal.

Prof. Dr. Julius Wagner of the newly founded Entomological Institute, Belgrade University, Jugoslavia, Krunska, F. F., A., desires to correspond with entomologists of this country and to receive their publications. He states that in a short time the Agronomic Section of Belgrade University, will begin publication of the work of the Experimental Stations and the Entomological Institute and that he will be pleased to send these in exchange for American literature.

Prof. Edward P. Thompson, Riverside, Calif., died May 19 of pneumonia. He was one of the founders of the Association of Economic Entomologists. A brief account of his part in that historic event is given by Dr. Howard on page 29 of this volume.

Science announces the formal retirement of Professor H. E. Summers as professor of zoology at Iowa State College and State Entomologist, a position to which he was

appointed in 1898. He will live in Los Angeles, California. Since his serious illness several years ago, Professor Summers has not been on active duty.

Entomological News announces the death of the following entomologists: George A. J. Rothney, England, January 31, 1922; Arthur W. Bacot, Cairo, Egypt, April 12, 1922; Henry Rowland Brown, England, May 3, 1922; Hans Frühstorfer, Munich, Germany, April 9, 1922; Dr. Otto Taschenburg, Halle, Germany, March 20, 1922; Louis Bedel, France, February 8, 1922.

Professor L. M. Peairs, head of the Department of Entomology of the University of West Virginia, visited the Department of Entomology at the Kansas State Agricultural College September 10th to 12th on his return from a vacation trip in California. Professor Peairs received his Master's Degree from the Kansas State Agricultural College in 1907.

Dr. E. D. Ball, director of scientific research, and Dr. L. O. Howard, Chief of the Bureau of Entomology, left Washington, October 12, for a short trip through the south. They were accompanied by Dr. H. A. Morgan, President of the University of Tennessee, and will study various phases of the boll weevil situation in Louisiana and Mississippi.

Recent visitors to the Bureau Laboratory at Fort Valley, Georgia, to observe peach insect investigations under way include Director H. P. Stuckey of the Georgia Experiment Station, Dr. J. J. Skinner, U. S. Bureau of Plant Industry, Agricultural Development Agents of the Railroads of the Southeastern States, and several groups of peach growers from South Carolina, Tennessee and Mississippi.

Dr. J. M. Swaine, Chief of the Division of Forest Insects, Entomological Branch, left Ottawa on August 17th for Saskatchewan and British Columbia to investigate outbreaks of forest insects and to go over the work of the Division in the latter province with Mr. Hopping. On his way west he stopped at the Porcupine Mts. to investigate a large outbreak of *Dendroctonus* on spruce.

Mr. Ernest R. Barber formerly of the Bureau of Entomology is now at the head of the Barber Entomological Laboratories at Canal and Baronne Streets, New Orleans, La., and is engaged in supplying Argentine ant poison prepared after the Government formula recommended in Farmers' Bulletin No. 1101. The Laboratories have made up nearly 140,000 gallons of this ant poison this fall and have supplied nearly 80 southern cities with this product to be used in ant control.

The railroads of the country have prohibited the use of carbon disulphid as a fumigant of grain in their rolling stock except at certain points, particularly at Baltimore and New Orleans. The U. S. Department of Agriculture has been called upon by them to investigate the possibility of finding a fumigant more suitable than carbon disulphid for grain fumigation and the Bureaus of Entomology and Chemistry have been co-operating in this investigation which has now been under way for several months.

A party of entomologists and agricultural commissioners visited the areas near Boston infested by the European corn borer on October 10. According to the newspapers, the following were present: Dr. A. W. Gilbert, Commissioner of Agriculture, Boston, Mass.; Dr. E. P. Felt, State Entomologist, and Dr. George G. Atwood, Director Bureau of Plant Industry, State Department of Agriculture, Albany, N. Y.; Professor W. C. O'Kane, State Entomologist, Durham, N. H., Professor A. E. Stene, State Entomologist, Kingston, R. I.; Dr. Henry T. Fernald, Professor of En-

tomology, Agricultural College, Amherst, Mass.; Mr. W. R. Walton, U. S. Bureau of Entomology, Washington, D. C.

The following resignations from the U. S. Bureau of Entomology have been announced recently: D. M. Dowdell, Jr., Mexican bean beetle project, to accept a position as instructor at the Mississippi Agricultural and Mechanical College; T. H. Frison, J. H. Painter, C. W. Rieman, 3d, and G. E. Spencer from the Japanese beetle laboratory, Riverton, N. J; Albert H. Amis, junior entomologist associated with A. O. Larson, bean weevil investigations, Alhambra, Calif., resigned September 25, to accept a position in Sinaloa, Mexico, under the direction of Dr. A. W. Morrill; temporary employees, boll weevil control: John R. Cole, R. C. Dancy, S. B. Hendricks, L. P. Hodges, E. F. Holley, J. E. Humphries, A. L. Monroe, W. D. Reed, Paul D. Saunders, A. Schultz, T. L. Wilkerson; tobacco insect investigations: E. F. Haden, L. N. Judah, M. L. MacQueen, H. C. Plummer, T. P. Weakley, W. B. Weakley.

The following statement regarding the progress of the campaign against the Argentine ant in New Orleans appeared in Florists Exchange for September 30, 1922:—"Virtually 3,000 blocks had been covered by the poisoners in the local ant extermination campaign when operations were suspended at the end of this week; the major part of the more heavily settled portions of the city lay blanketed with 350,000 cans of the compound. The indications are that the scattered portions in the area below Canal St., would be attended to early next week. Uptown the distribution has progressed over a slightly smaller area. In three weeks as much has been performed as it was estimated could be accomplished in five. At the present rate the middle of next month will witness the completion of the task. Temporary suspension may be caused by a lack of sponges needed for the work.

Recent preliminary examinations for the presence of Japanese beetle larvae in fields in the vicinity of the laboratory at Riverton, N. J., show a heavy increase in the number of grubs compared with the number present a year ago this time, in some cases running as high as 100 per cent. or more increase. It is expected that the regular grub survey to be made a little later in the fall will show a general increase in density of grub infestation throughout the infested territory as a whole. A serious injury to a number of the greens in local golf courses, as a result of the abundance of Japanese beetle larvae, has been found. The greens offer ideal facilities for egg depositions by the beetle during the season, and it is quite apparent that the effect of these heavy egg depositions will be serious, possibly necessitating the rebuilding of infested greens.

On September 6th, Messrs. D. J. Caffrey and G. W. Barber of the European Corn Borer Laboratory at Arlington, Mass., maintained by the United States Department of Agriculture, visited the Port Stanley Laboratory, Ont., and investigated the control work being carried on for the European Corn Borer in that region. September 7th and 8th were Ohio days at the Port Stanley Laboratory. A party of forty-three officials, county agents and farmers from the State of Ohio visited the European Corn Borer outbreak in the vicinity of Port Stanley. They arrived from Cleveland on the afternoon of the 7th, coming across Lake Erie on the Ohio Fish and Game Commission boat. The object of the trip, which was organized by the Ohio Department of Agriculture, was to bring to the attention of the farmers and county agents the necessity of co-operative action in sections where the pest was abundant and doing extensive damage. The party was in charge of Mr. L. J. Taber, Director

of Agriculture for Ohio, and included Messrs. E. C. Cotton, Raymond C. Osburn, Herbert Osborn, H. A. Gossard, J. S. Houser, T. A. Parks, and N. E. Shaw. Messrs. W. R. Walton and L. H. Worthley of the U. S. Bureau of Entomology also spent two days at the Laboratory. The visitors were conducted on their trips by Messrs. McLaine, Crawford, and Keenan of the Entomological Branch and Capt. George Spencer of the Provincial Department of Agriculture.

Pacific Slope Notes

Mr. C. T. Dodds spent the summer in Sinaloa, Mexico, assisting R. H. Van Zwaluenberg in introduction, breeding and liberation of parasites of the sugar cane borers.

Mr. A. W. Morrill of Los Angeles spent the first two weeks of September in the State of Sinaloa, Mexico, in connection with contracts with growers and shippers organizations for advisory services.

Mr. F. H. Wymore, recent graduate in Entomology, University of California, has been appointed as special investigator of the asparagus centipede in connection with work for a Master's Degree.

Mr. Albert H. Amis of the Stored Product Insect Investigations of the Bureau of Entomology, stationed at the Alhambra, California, laboratory, has resigned to accept a position with Dr. A. W. Morrill, consulting entomologist of Los Angeles. Mr. Amis will be located at Los Mochis, Sinaloa, Mexico, the principal vegetable growing and shipping point on the Mexican West Coast, and in addition to entomological advisory services and investigations, will conduct general agricultural experiments relating to plant disease control, fertilizers, irrigation and cultural methods.

Mr. Eric Hearle, Assistant Entomologist in charge of mosquito investigations, Entomological Branch, Canadian Department of Agriculture, is now in the Rocky Mountain Park, Banff, Alta., where a temporary laboratory has been provided by the Dominion Parks Branch of the Department of the Interior. A biological study of the mosquitoes of the region is being undertaken and close co-operation in the control work has been established with the officials of the Park. Mr. Hearle reports that resulting from the spring control work, there has been a decided decrease in the number of adult mosquitoes present. (Accidentally omitted from the October issue although there was editorial reference thereto).

Horticultural Inspection Notes

Messrs. E. N. Cory of Maryland and W. J. Schoene of Virginia, attended the Bulb Conference held in Washington on October 30, 1922.

Mr. Harvey A. Horton, who has been stationed at Eagle Pass, Texas, for the past two years, was recently transferred to the port of Seattle for the purpose of assisting in ship inspection.

A shipment of 1,000 sacks of walnuts arrived at the port of Vancouver on August 17th and were refused entry by Chief Provincial Inspector Lyne on account of being infested by *Plodia interpunctella*.

Mr. H. H. Willis, in charge of the inspection and fumigation works of the Federal Horticultural Board at El Paso, Texas, has been temporarily transferred to Washington to assist in the inspection of plants introduced under Special Permit.

Messrs. Faustino Q. Otanes and N. G. Tedoro of the Philippine Islands, who have recently completed courses at the Universities of Illinois and Wisconsin respectively, have during the months of October and November been studying the inspection and disinfection methods employed by the Federal Horticultural Board in Washington.

The number of foreign shipments of nursery stock arriving under Special Permit in Washington during the fall shipping season of 1922 is more than double the number received during the same period of 1921. The season opened about two weeks earlier this year than usual. Shipments arriving thus far include orchids, bulbs, herbaceous perennials, and shrubs.

Mr. Lee A. Strong, Chief, Bureau of Plant Quarantine of the State of California, left Sacramento September 1 for the purpose of studying the port inspection methods employed in New York, Boston, Philadelphia, and Washington. While in the east, Mr. Strong visited the Japanese beetle laboratory at Riverton, N. J., and the bean beetle laboratory at Birmingham, Alabama.

Mr. E. R. Sasscer, entomologist in charge of the plant quarantine inspection service of the Federal Horticultural Board, returned the middle of September from an inspection trip of the ports of entry along the Mexican border and the Pacific Coast. During this trip he had conferences with customs officials, port office officials and various state officials, with a view to strengthening the plant quarantine inspection service.

The European Tulip Aphid, *Anuraphis tulipae* Boyer, is found to be present this season, as in previous years, in nearly every shipment of iris rhizomes received from Europe. It is also being found occasionally on Spanish iris bulbs. The insect is apparently quite common in western Europe, having been taken repeatedly on plants from England, France, and Holland. There are only a few records of the finding of this species in the United States, and its distribution may be quite local

Larvae of the Narcissus and Lesser Bulb Flies have been frequently found in Narcissus bulbs from France and Holland during the bulb shipping season, which has just been completed. One shipment consisting of eight cases of French bulbs arriving in New York, which was carefully examined, showed from one to five per cent. of the bulbs to be infested with *Merodon equestris.* A shipment of eighty-seven cases, for the most part Narcissus bulbs, arriving at Philadelphia from Holland, was found to be infested with both *Merodon equestris* and *Eumerus strigatus.* From one hundred to two hundred bulbs, examined in eighteen cases, exhibited an infestation varying from one to twelve and one-half per cent. One bulb examined by Mr. H. L. Sanford was found to contain seventy-seven larvae of *Eumerus strigatus*.

Dr. L. O. Howard Addresses Louisiana Entomological Society

Dr. L. O. Howard, Chief of the Bureau of Entomology, was the speaker at a meeting of the Louisiana Entomological Society at the Natural History Building, Jackson Square, New Orleans, on October 18th, 1922.

Dr. Howard chose for his subject the idea that all entomologists are economic entomologists. Formerly, especially in Europe, collectors and systematists held the view that theirs is the only true science of entomology. This opinion has now changed until there is danger of the economic entomologist setting himself up as the only real scientist as far as entomology is concerned. As a matter of fact, all phases of the science go hand in hand, and all are necessary for good economic work. The value of the systematist is illustrated by the discovery this spring of a new potato weevil in southern Mississippi. This was sent to the Bureau of Entomology by the Mississippi State Plant Board, it was identified by the museum workers, the probable country of its origin was ascertained, references to previous studies were found, and before any information could be obtained by experiments in Mississippi a great deal was known of the new enemy to potatoes.

In the war against insects, as in every other conflict, it is necessary to know what we are fighting. This information is supplied by the systematic worker, who should by no means be looked down upon by the economic entomologist and the general public as a bespectacled individual examining dead specimens through which he has thrust pins, but should be accepted as an ally and an important one in the battle.

Dr. Howard delighted his audience with entomological reminiscences told in his own inimitable style. The customs and the membership of the various entomological societies of this country and Europe were compared. Dr. Howard then answered questions on a number of subjects, and a sort of conversazione followed.

At its conclusion the members, though deeply conscious of the fact that they were honoring their Society rather than conferring any additional renown on Dr. Howard, unanimously elected him to honorary membership.

The meeting was attended by the following Members:—Dr. Howard, Messrs. Ed. Foster, R. T. Hobson, W. E. Haley, James M. McArthur, Wm. E. Upton, H. T. Mead, Percy Viosca, E. R. Barber, O. W. Rosewall, T. E. Holloway. Visitors—Mrs. H. T. Mead, Mrs. E. R. Barber, Mrs. T. E. Holloway, Prof. R. W. Harned, Mr. E. K. Bynum, and Messrs. Benedict, Venable, Cunningham and Bertram.

T. E. HOLLOWAY.
Secretary-Treasurer

Instructions for Binding

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PLATE 4 (5 on reverse). Insert to face page 270.

INDEX

Thirty-fifth Annual Meeting of the American Association of Economic Entomologists, Boston, Mass., December 28 to 30, 1922.

THIRTY-FIFTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS, BOSTON, MASS., DECEMBER 28 TO 30, 1922.

The 35th annual meeting of the American Association of Economic Entomologists will be held at the Massachusetts Institute of Technology, Massachusetts Ave., Cambridge, Mass., December 28 to 30, 1922.

Sessions will open at 10 a. m., Thursday, December 28. Business will be transacted and the annual reports of the officers and standing committees will be presented. This will be followed by the annual address of the President. Meetings will continue morning and afternoon in the same building until Saturday afternoon, when the final business will be transacted. No evening sessions of this association will be held in this building.

Sectional Meetings

The meeting of the Section of Apiculture will be held at 8 p. m., Thursday, December 28, in the Auditorium of the Boston Society of Natural History, Berkeley Street, Boston.

The Section of Horticultural Inspection will meet at 9:30 a. m., Friday, December 29, at the Massachusetts Institute of Technology.

Joint Meetings

The joint meeting of this association and the American Phytopathological Society will be held on Saturday, December 30, at 9:00 a. m.

Other Meetings

The annual meeting of the American Association for the Advancement of Science and many of its Sections and Affiliated Societies will be held throughout the week.

The Entomological Society of America will open its meeting on Tuesday, December 26, 1:30 p. m. The meeting will continue on Wednesday, and the annual public address will be delivered by Dr. W. M. Wheeler, at 8 p. m. On Friday, December 29, a session will be held at 10 a. m.

Entomologists interested in the Insect Pest Survey and in extension work, will hold a meeting Tuesday evening, December 26, at 8 p. m., in the Auditorium of the Boston Society of Natural History, Berkeley Street, Boston.

Members of this association and of the Entomological Society of America who are interested in medical entomology, will meet in joint session with the members of Section N, on Friday, December 29, at 1:30 p. m.

Exhibits

Exhibits of interest to visiting entomologists will be held convenient to the room where the general sessions are held at the Massachusetts Institute of Technology.

The field and experimental work on the Gipsy Moth and the European Corn Borer will be illustrated, also the methods used in fumigating cotton and other material in the vacuum cyanide fumigating plants in Boston.

An opportunity will be given visiting members to see a plant in operation. One of those located in Boston is the largest of its kind in the world.

The Section of Apiculture will also have an instructive and interesting exhibit.

Hotel Headquarters

Hotel headquarters of this association will be at the Brunswick Hotel, Copley Square, Boston, where the following rates have been secured:

Single rooms, accommodating one person, with bath, $4 and $5 a day; without bath, inside, $2.50 and $3 a day; outside, $3 and $3.50.

Double rooms, accommodating two persons, with bath, $6 and $7 a day; without bath, $4.50 to $6 a day.

All rooms without bath are equipped with running hot and cold water.

Members must engage rooms promptly, as hotel accommodations are limited.

Railroad Rates

Reduced rates will undoubtedly be arranged for this meeting, but definite information is not now at hand.

Members can secure information prior to the time of the meeting, from their local railroad agent or from Dr. Burton E. Livingston, Permanent Secretary, American Association for the Advancement of Science, Smithsonian Institution, Washington, D. C.

Dinner

An entomologists' dinner will be held Friday evening, December 29. Details will be announced at the time of the meeting.

Membership

Applications for membership should be secured from the Secretary or from the committee on membership. They should be filled out, properly endorsed, and filed with the membership committee on or before December 29. Every application must be accompanied with fee of $3.50 to cover dues and subscription to the JOURNAL OF ECONOMIC ENTOMOLOGY for the year following election.

Program

Tuesday, December 26, 1922, 8 p. m.

(Auditorium, Boston Society of Natural History, Berkeley St., Boston)

Meeting of entomologists interested in the Insect Pest Survey and in Extension Entomology.

Mr. J. A. Hyslop will present a paper entitled, "Entomological Survey work in the United States."

The evening will be spent in conferences on these important matters and program will be ready at the time of the meeting.

Program

Thursday, December 28, 1922, 10 a. m.

(Massachusetts Institute of Technology, Cambridge, Mass.)

Report of the Secretary.

Report of the Executive Committee, by President J. G. Sanders.

Report of the Delegate appointed to attend conference concerning Federation of American Biological Societies, by A. F. Burgess, Melrose Highlands, Mass.

Report of the Representative to the National Research Council, by George A. Dean, Manhattan, Kansas.

Report of the Committee on Policy, by George A. Dean, Manhattan, Kansas.

Report of the Trustees of the Crop Protection Institute, by W. C. O'Kane, Durham, N. H.

Report of the Committee on Nomenclature, by Edith M. Patch, Orono, Me.

Report of the Committee on Index to Economic Entomology, by E. P. Felt, Albany, N. Y.

Report of the Committee on U. S. National Museum, by J. J. Davis, Lafayette, Ind.

Appointment of Committees.

Miscellaneous business.

New business.

Annual Address of the President, J. G. Sanders, Harrisburg, Pa., "Whither in Entomology?"

READING OF PAPERS

"Problems in Economic Entomology," by E. P. Felt, Albany, N. Y. (15 minutes).

General discussion of some of the larger phases of control work.

"Choice of Food and Numerical Abundance Among Insects," by C. T. Brues, Boston, Mass. (15 minutes). Lantern.

A discussion of monophagous and polyphagous species in reference to their abundance under natural and agricultural conditions, and the biological and economic conclusion to be drawn therefrom.

"The Obligation that Economic Entomology owes to Forestry," by S. A. Graham and A. G. Ruggles, St. Paul, Minn. (15 minutes).

A consideration of forest insect problems in Minnesota.

Adjournment.

Program

Thursday, December 28, 1922, 1:30 p. m.

(Massachusetts Institute of Technology, Cambridge, Mass).

Discussion of the Presidential Address.

Reading of Papers

"Some Experiments in the Control of the Cabbage Maggot," by W. H. Brittain, Truro, N. S. (15 minutes).

"Mercuric Chloride—Its Use for the Control of Root Maggots in Cabbage Seed Beds," by Hugh Glasgow, Geneva, N. Y. (7 minutes). Lantern.

A comparison of the Mercuric Chloride treatment and the cheese cloth screen for protecting cabbage seed beds from the root maggot.

"Effect of Variety and Date of Planting upon Leafhopper Injury to Potatoes," by F. A. Fenton, Ames, Iowa. (5 minutes).

"Green June Beetle as a Tobacco Pest," by Z. P. Metcalf, Raleigh, N. C. (5 minutes). Lantern.

The grubs of the Green June Beetles are frequently serious pests of the tobacco beds.

"The Squash Bug in Massachusetts," by H. N. Worthley, Amherst, Mass. (5 minutes).

A summary of three years observations on life history and control, together with an account of the relation of the parasite *Trichopoda pennipes* to its host, the squash bug. (Control trials negative.)

"The Onion Capsid," by P. A. Glenn, Urbana, Ill. (5 minutes).

Attacks and breeds in wild onions and when adult stage is reached, fly to cultivated onion which they injure seriously. Life history and method of control.

"A New Pest of Peppers and Egg Plants,—*Zonema electa* Say—Trypetidae," by Alvah Peterson, New Brunswick, N. J. (15 minutes). Lantern.

Notes on injury and life history of a new maggot in the fruit of pepper plants and egg plants.

"Dusting for the Pea Aphis," by E. N. Cory, College Park, Md. (5 minutes). Lantern.

Various materials tested. Methods of application. Results.

"Dusting versus Spraying on Beans for the control of *Empoasca mali* LeB.," by A. H. Beyer, Gainesville, Fla. (15 minutes). Lantern.

The results of experiments conducted in Florida the past summer and fall for the control of Bean Leafhopper on beans.

"The Possibility of Transmitting a Weevil (*Sitophilus*) infestation from wheat to macaroni through the process of milling and manufacturing," by Royal N. Chapman, St. Paul, Minn. (10 minutes). Lantern.

Experimental evidence to show that no stages of the granary weevil survive the process of milling wheat, or mixing and pressing macaroni.

"Feeding Cows Insect-infested Cocoanut meal," by R. W. Doane, Stanford University, Calif. (10 minutes).

Records insects found in copra cakes and gives results of feeding experiments in which cocoanut meal made from badly infested copra cakes were fed to dairy cattle.

"Vacuum Fumigation Experiments Using European Corn Borer & Brown-tail Moth Larvae Under Winter Conditions," by R. I. Smith, Boston, Mass. (10 minutes).

Two year's experiments to prove that these insects are not killed by cyanide fumigation at low temperatures.

"Further Data on Fumigation with Hydrocyanic-acid Gas in Greenhouses on a Commercial Basis," by E. R. Sasscer and C. A. Weigel, Washington, D. C. (10 minutes).

Additional data on the practicability of frequent fumigations with Hydrocyanic-Acid Gas, using a low concentration of gas.

"Dusting Tall Trees by Airplane for Leaf-eating Insects," by J. S. Houser, Wooster, Ohio. (15 minutes). Lantern. Moving pictures.

"Experiments in dusting Forest Areas with an Airplane," by A. F. Burgess, Melrose Highlands, Mass. (15 minutes). Lantern.

"Results of Spraying and Dusting for the Control of the red spider (*Paratetranychus pilosus* Can. & Fran.)," by D. M. DeLong, Columbus, Ohio. (7 minutes).

"The Insecticidal Properties of Tobacco Dust," by P. J. Parrott & Hugh Glasgow, Geneva, N. Y. (10 minutes).

Summarizes the principal results of experiments with tobacco dusts, incorporated in dusting and spraying mixtures, in controlling the apple red bug, the rosy aphis and other aphids.

"Some Further Experience with Nicotine Dusts," by. T. J. Headlee, New Brunswick, N. J. (15 minutes).

Deals primarily with the use of the dolomite nicotine dust in the field.

"Spreader Tests on Apples and Peaches," by L. A. Stearns, Leesburg, Va., and W. S. Hough, Blacksburg, Va. (10 minutes).

Paper concerns Casein and Flour-Paste Spreader tests on fruits mentioned.

"Spreaders in relation to theory and practice in orchard spraying." by R. H. Smith, San Francisco, Calif. (8 minutes).

Summary of present status of spreaders and a report of investigation by the author.

"Results of an Oil Spray in Treatment of Box Leaf Miner (*Monarthropalpus buxi*)," by J. K. Primm and E. A. Hartley, Oak Lane, Pa. (10 minutes).

"Bordeaux Mixture as a control against Leafhoppers," by F. A. Fenton and J. H. Trundy, Ames, Iowa. (5 minutes).

Adjournment.

SECTION OF APICULTURE

M. C. TANQUARY, *Chairman* G. M. BENTLEY, *Secretary*

Thursday, December 28, 8:00 p. m.

(Boston Society of Natural History, Berkeley Street, Boston)

Address by the Chairman, M. C. Tanquary, College Station, Texas, "Relation of the Texas Agricultural Experiment Station to Beekeeping in Texas."

READING OF PAPERS AND DISCUSSIONS

"Utilization of Various Carbohydrates as Food for the Honey-bee," by E. F. Phillips, Washington, D. C.

"A Two Year's Brood Curve for a Single Colony of Bees," by W. F. Nolan, Washington, D. C.

"Legislation to Protect the American Beekeeper Against the Isle-of-Wight Disease," by S. B. Fracker, C. B. Gooderham, and George H. Rea.

"Isle-of-Wight Disease with Special Reference to Geographical Distribution," by E. F. Phillips, Washington, D. C.

"Investigation of the Queen," by F. B. Paddock, Ames, Iowa.

"Value of Winter Protection for Bees," by J. H. Merrill, Manhattan, Kan.

"Rehabilitation Classes in Apiculture," by E. N. Cory, College Park, Md.

Report of Committees.

Selection of Officers.

Adjournment.

SECTION OF HORTICULTURAL INSPECTION

R. W. Harned, *Chairman* E. R. Sasscer, *Secretary*

Program

Friday, December 29, 9:30 a. m.

(Massachusetts Institute of Technology, Cambridge, Mass.)

Address by the Chairman, R. W. Harned, Agricultural College, Miss.

Reading of Papers and Discussions

"Recent Work of the Federal Horticultural Board," by C. L. Marlatt, Washington, D. C. (15 minutes).

"Bugs, Bugologists, Bugaboos, and Nurserymen," F. F. Rockwell, Chairman Development Committee, American Association of Nurserymen, Bridgeton, N. J. (15 minutes).

"Inspecting Nursery Stock at Digging Time," by Leonard Haseman, Columbia, Mo. (10 minutes).

"Important Foreign Plant Diseases Collected on Imported Nursery Stock in 1922," by R. Kent Beattie, Washington, D. C. (15 minutes).

"Important Foreign Insects Collected on Imported Nursery Stock in 1922," by E. R. Sasscer, Washington, D. C. (15 minutes).

"The Gipsy Moth in New Jersey," by T. J. Headlee, New Brunswick, N. J. (5 minutes).

Round Table Discussion of Nursery Stock Fumigation lead by G. A. Arnold, Agricultural College, Miss. (30 minutes).

Report of Committees.

Selection of Officers.

Adjournment.

Program

Friday, December 29, 1922, 1:30 p. m.

(Massachusetts Institute of Technology, Cambridge, Mass.)

Symposium:—

"Standards for the training of men who are to enter professional entomology."

(Ten minute limit on papers)

HERBERT OSBORN—Personal Contact with the Student of Entomology.

WILLIAM A. RILEY—Morphology and Technique for the Student of Entomology.

WILLIAM MOORE—The need of Chemistry for the Student of Entomology.

W. C. O'KANE—The Entomologist and the Public.

E. D. BALL—Courses for the Postgraduate Student.

A. L. QUAINTANCE—The Employer's Viewpoint on an Entomologist.

V. L. KELLOGG—Extra-entomological Studies for the Young Entomologist.

Question Box: Discussions:

1. How can the instructor maintain a vital interest on the part of students who are taking a beginning course in Economic Entomology as a required subject in agricultural courses, but who have no intention of specializing in Entomology?

2. How can students be helped to see the work of insects and their control under field conditions when the instructor has them only at a time of year when many important species are not active?

3. How can the necessary laboratory work in the structure of insects, for example, be made definitely interesting to the average non-specializing student?

READING OF PAPERS

"The Spread of the Japanese Beetle, *Popillia japonica*," by C. H. Hadley and L. B. Smith, Riverton, N. J. (10 minutes).

Resumé of annual rate and extent of spread, and factors influencing spread, for last five years.

"Rapid Spread of the Apple and Thorn Skeletonizer, *Hemerophila pariana* Clerck," by W. E. Britton, New Haven, Conn. (10 minutes).

Chronicles the rapid distribution and great abundance of this insect, particularly in Connecticut.

"Shall we Change our recommendations for controlling San Jose Scale?" by W. P. Flint, Urbana, Ill. (10 minutes). Lantern.

San Jose Scale has been increasing in Illinois the past three seasons with heavy infestation. Poor success has been obtained. Home made lubricating oil has given fairly good control.

"A Study of the Lethal Dosage for the Codling Moth Larva," by L. Haseman, Columbia, Mo. (10 minutes).

This paper will deal first with the distribution of and measure of arsenic placed on or in the blossom cups of apples by spraying and second with experimental results in feeding measured doses of arsenate of lead to apple worms of varying ages.

"A New Apple Bud-moth in Pennsylvania (*Sparganothis idaeusalis* Wlk.)," by S. W. Frost, Arendtsville, Pa. (5 minutes).

"The Effect of Leaf-hopper Injury on the Sugar Content of Grapes," by D. L. Van Dine, State College, Pa. (15 minutes).

Sugar content of grapes as an index to the efficiency of nicotine in leaf hopper control.

"Recent Developments in Plum Curculio Investigations in Georgia," by O. I. Snapp, Fort Valley, Ga. (15 minutes).

New discoveries in the life history of the insect and summarized results of some control experiments.

"The Strawberry Crown borer in Tennessee; its life history and control," by S. Marcovitch, Knoxville, Tenn. (8 minutes).

"Control of the Strawberry Root-worm in Commercial Rosehouses," by C. A. Weigel and C. F. Doucette, Washington, D. C. (10 minutes) Lantern.

Summarized results of three years investigations on the control of this pest in commercial greenhouses.

Adjournment.

Friday, December 29, 1922, 7 p. m.

Entomologists' dinner. Details will be announced during the meeting.

Program

Saturday, December 30, 1922, 9:00 a. m.

(Massachusetts Institute of Technology, Cambridge, Mass.)

Joint Meeting, American Association of Economic Entomologists and American Phytopathological Society.

Subject: Plant Quarantines.

C. L. Marlatt, Washington, D. C.:—"The When and Why of Plant Quarantines."

Wilmon Newell, Gainesville, Fla.:—"Tropical and Sub-Tropical Quarantines."

LEE A. STRONG, San Francisco, Cal.:—"Western Views on Plant Quarantines."

W. A. MCCUBBIN, Harrisburg, Pa.:—"Factors Contributing to Success in Domestic Quarantines."

W. A. ORTON, Washington, D. C.:—"Biological Basis of Foreign Plant Quarantines."

General Discussion.

Adjournment.

Program

Saturday, December 30, 1922, 1:30 p. m.

(Massachusetts Institute of Technology, Cambridge, Mass.)

READING OF PAPERS

"Another Important Step in the Control of the Hessian Fly in Kansas," by George A. Dean, Manhattan, Kansas. (10 minutes).

"The Resistance of Wheat to the Hessian Fly,—A Progress Report," by James W. McColloch, Manhattan, Kansas. (15 minutes).

A summary of the experiments on the resistance of different varieties of wheat to Hessian fly injury.

"Some Studies of Hessian Fly Behavior," by T. H. Parks, Columbus, Ohio. (10 minutes). Lantern.

Five years of observations on relations of time of seeding and the fall infestation.

"Summary of the Research Activities on the European Corn Borer," by D. J. Caffrey, Arlington, Mass. (15 minutes).

"The Economic Importance of *Crambus caliginosellus* Clemens," by George G. Ainslie, Knoxville, Tenn. (5 minutes).

A short sketch of the damage done by this species and the locations where trouble may be expected. A brief summary of the life history.

"Control of *Popillia japonica* larvae in golf greens," by B. R. Leach, Riverton, N. J. (5 minutes).

Experiments in preparation and application of carbon disulphide emulsions for control of larvae in turf.

"Observations on the Resistance of Certain Sorghums and their Hybrids to Chinch Bug Injury," by William P. Hayes, Ithaca, N. Y. (15 minutes). Lantern.

Crosses of Kansas Orange Cane and Dwarf Milo indicate resistance and segregation in F_2 generation.

"The Pale Western Cutworm in North Dakota," by R. L. Webster, Agricultural College, N. D., and C. N. Ainslie, Sioux City, Iowa. (10 imnutes). Lantern.

History, Distribution, Injury, Present Status.

"The Biology of the Cloaked Knotty-horn beetle (*Desmocerus palliatus*)," by Glenn W. Herrick, Ithaca, N. Y. (5 minutes).

"Charting Life Histories," by H. T. Fernald, Amherst, Mass. (5 minutes).

"A Limiting Factor in the Abundance of Certain Parasitic Fossorial Hymenoptera," by Theodore H. Frison, Urbana, Ill. (5 minutes).

Certain fossorial Hymenoptera, important white grub parasites, are often common in one vicinity and not in another. As the adults are succivorous, the absence of a suitable nectarous food supply is one of the limiting factors in their numerical abundance. It is suggested that the propagation of certain plants in suitable situations on golf courses or other areas, may somewhat lessen the damage caused by white grubs.

"A Japanese Tachinid Parasite of the Oriental Moth," by J. N. Summers, Melrose Highlands, Mass. (3 minutes).

"Kernel Spot of Pecan, (a Stigmanose caused by Pentatomids, particularly *Nezara viridula*)," by W. F. Turner, Atlanta, Ga. (10 minutes.)

The injury first reported as a disease, proves to be purely a mechanical (or physical) injury caused by the bug's feeding. Paper contains data on this, together with data on stages of kernel when injury can occur and notes on relation of insects to nuts and to legumes, etc., which are its natural food and breeding hosts.

"Food Habits of Some Galerucini," by W. C. Woods, Middletown, Conn. (6 minutes).

Studies of larval and adult host plants of 10 species of Galerucella.

"Notes on the Insect Pests of Utah," by I. M. Hawley, Logan, Utah. (5 minutes).

Insects injurious in 1922 and report on some recently introduced, etc.

"Prevention of Losses of Domestic Fowl through eating Rose Chafers," by G. H. Lamson, Jr., Storrs, Conn. (10 minutes).

"Observations on Tabanidae (Horse-flies) in Louisiana," by T. H. Jones and W. G. Bradley, Baton Rouge, La. (10 minutes).

Summary of stud ies made during past year on larvae and adults.

Final Business

Report of committee on resolutions.

Report of committee on membership.

Report of other committees.

Nomination of Journal officers by advisory committee.

Report of committee on nominations.

Election of officers.

Miscellaneous business.

Fixing the time and place of next meeting.

Final adjournment.

J. G. Sanders, *President*,
Harrisburg, Pa.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.